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ABSTRACT

This color-coded teacher's guide contains curriculum materials designed to help students develop an awareness of renewable and nonrenewable natural resources and to identify occupations in the area of natural resources. The guide contains nine units, each of which includes some or all of the following basic components: objective sheet, suggested activities for the teacher, instructor supplements, transparency masters, information sheet, assignment sheets, assignment sheet answers, job sheets, practical tests, written test, and answers to written test. Units cover the following topics: introduction to natural resources and conservation; water resource management; land management; air resource management; wildlife management; wildlife habitats; outdoor recreation; forestry; and energy resources. All of the units focus on measurable and observable learning outcomes. They are designed for use in more than one lesson or class period of instruction. (KC)

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INTRODUCTION TO

Natural Resources

Teacher Edition

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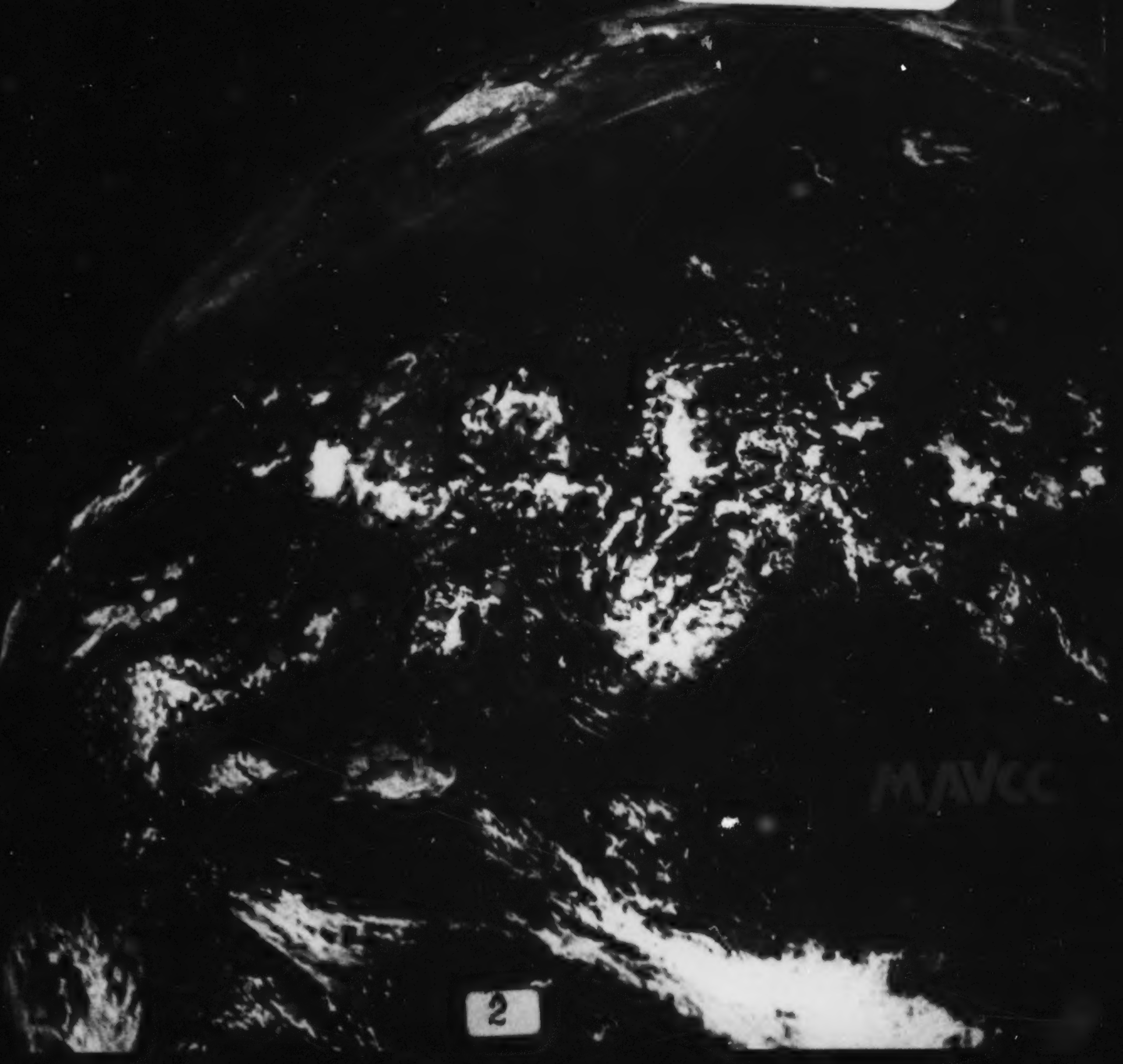

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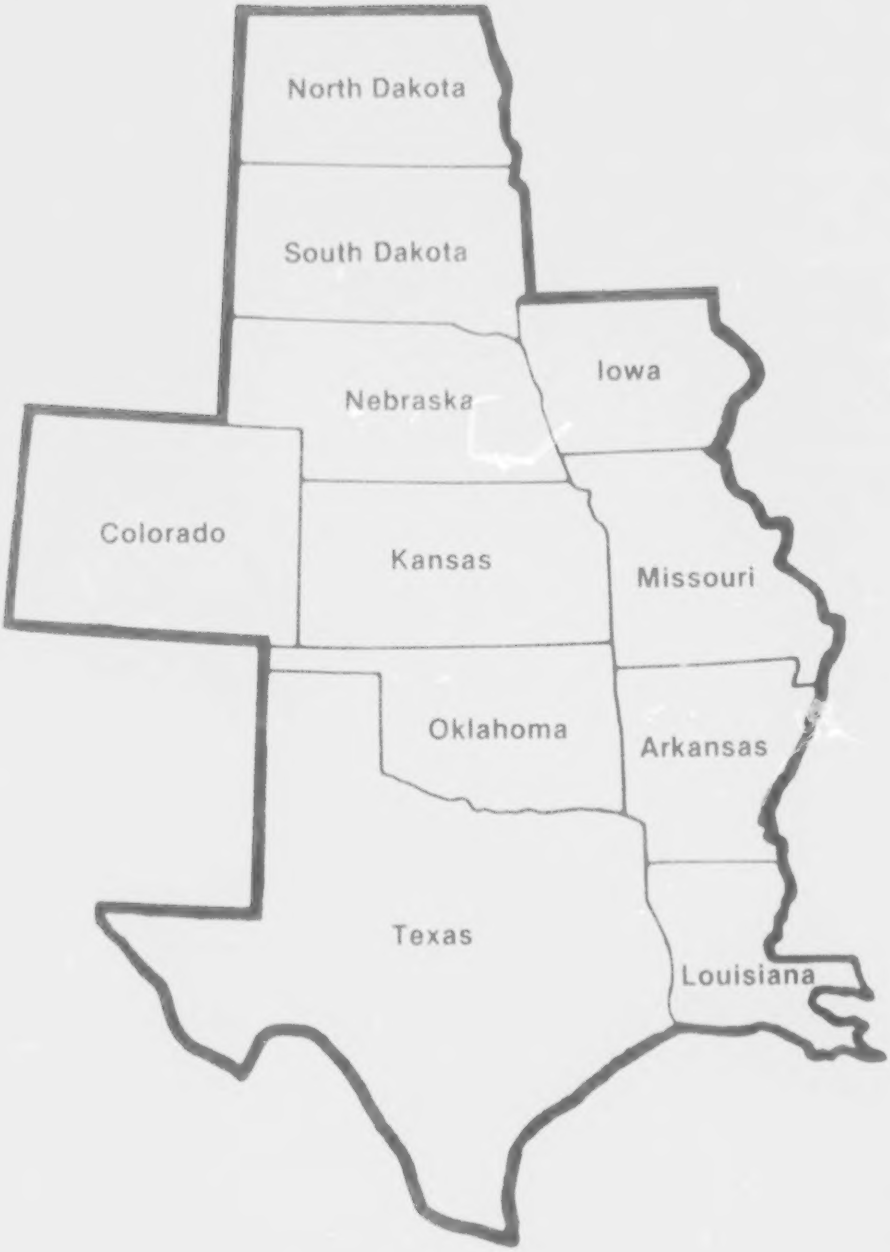
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Introduction to Natural Resources

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INTRODUCTION TO NATURAL RESOURCES

TABLE OF CONTENTS

Unit I: Introduction to Natural Resources and Conservation 1

Unit II: Water Resource Management 55

Unit III: Land Management 101

Unit IV: Air Resource Management 157

Unit V: Wildlife Management 205

Unit VI: Wildlife Habitats 255

Unit VII: Outdoor Recreation 317

Unit VIII: Forestry 363

Unit IX: Energy Resources 419

6

FOREWORD

The Mid-America Vocational Curriculum Consortium (MAVCC) was organized for the purpose of developing instructional materials for its member states. All member states participate in establishing annual development priorities, and the need for curriculum in natural resources truly reflects regional needs.

Introduction to Natural Resources is in response to the changes being made to diversify the agriculture education curriculum. The target audience for this publication is secondary students who may or may not have completed other agriculture education courses, but are interested in learning more about the careers and technologies available in the natural resources area.

The primary objective of the *Introduction to Natural Resources* publication is that the student should develop an awareness of renewable and nonrenewable natural resources and identify occupations in the area of natural resources. This publication is only the starting point. Teachers are encouraged to read the suggested activities section for each unit of instruction. The materials are designed so that teachers may localize/personalize/supplement the units to fit their situation. The materials may be expanded to fit teacher and student interests and to meet new and emerging natural resource issues.

The success of this publication is due to: (1) teacher response that has helped place the MAVCC format in the forefront in competency-based instructional materials and (2) the people who worked on its development. The technical writers, committee representatives, and curriculum specialist brought with them technical expertise and experience in the area of natural resources.

It is the sincere belief of MAVCC and all those who worked on this publication that *Introduction to Natural Resources* will improve student performance and teacher effectiveness. Every effort has been made to make this publication basic, readable, and by all means usable. If there is anything we can do to help this publication become more useful to you, please let us know.

Jim Steward
Executive Director
Mid-America Vocational
Curriculum Consortium

Ann Masters, Chairman
Board of Directors
Mid-America Vocational
Curriculum Consortium

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Appreciation is extended to those individuals who contributed their time and talent to the development of *Introduction to Natural Resources*.

The contents of this publication were planned and reviewed by the following members of the Mid-America Vocational Curriculum Consortium natural resource committee:

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U.S. Soil Conservation Service
Soil and Water Conservation Society
Oklahoma Curriculum and Instructional Materials Center

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Thanks are also extended to Mary Kellum, MAVCC Curriculum Specialist, for her assistance with the editing of this book, as well as the coordination of the project.

USE OF THIS PUBLICATION

Instructional Units

Introduction to Natural Resources contains nine units of instruction. Each instructional unit includes some or all of the basic components of a unit of instruction; performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the tests. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period.
B. The skills which must be demonstrated
    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations
C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

The instructor should demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances which might reasonably be expected from a person who has had this training.

10

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

INTRODUCTION TO NATURAL RESOURCES

TOOLS, MATERIALS, AND EQUIPMENT LIST

Paper and pencil
Telephone book or business directory
Assortment of trash
Soil tube, soil auger, garden trowel, or spade
Plastic bucket
Soil sampling information sheet
Kit to test soil for organic matter
Test tube and stopper
Test tube rack
Sodium hydroxide
Spoon
Eye dropper
Glass jar with lid
Soil samples
Shovel
Yardstick
Plastic sheeting
Peat moss or other organic matter
Bareroot tree
Diameter tape
Carpenter tape
Tree scale stick (Biltmore)
100 foot tape
Reference library
Safety equipment such as gloves, hard hats, eye and ear protection

(NOTE: You also need to arrange for county or state air monitoring, soil testing, and water analysis so students can complete corresponding Assignment Sheets.)

INTRODUCTION TO NATURAL RESOURCES

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INTRODUCTION TO NATURAL RESOURCES

INSTRUCTIONAL / TASK ANALYSIS

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

UNIT I: INTRODUCTION TO NATURAL RESOURCES

1. Terms and definitions
2. Definition of natural resources
3. Renewable and nonrenewable natural resources
4. Basic components of the physical environment
5. History of natural resources
6. Importance of natural resources
7. Conflicts in natural resource management
8. Factors which harm natural resources
9. Preservation and conservation of natural resources
10. Preservation activities
11. Conservation activities
12. Categories of solid waste
13. Composition of solid waste in a municipal landfill
14. Methods of waste disposal
15. Waste reduction activities
16. Recyclables and nonrecyclables
17. Federal agencies responsible for natural resources

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)
18. Types of occupations in natural resources	
19. Ways of getting a job in natural resources	
20. Characteristics of a person working in natural resources	
	21. Report on a local natural resource problem
	22. Report on a current event affecting natural resources
	23. Identify recycling centers in your area
	24. Determine what is recyclable
	25. Identify occupations of interest

UNIT II: WATER RESOURCE MANAGEMENT

1. Terms and definitions
2. History of water in the U.S.
3. Water distribution
4. Uses of water
5. Hydrologic (water) cycle
6. Surface water
7. Ground water
8. Relationship between ground water and surface water
9. Water pollution
10. State of the environment in 1960 and 1990
11. Hazardous/toxic waste
12. Federal legislation for environmental protection of water resources

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)
13. Watersheds	
14. Water measurement terms and equivalents	
15. Career opportunities in water resource management	
	16. Survey your area to identify water pollution sources
	17. Evaluate your source of drinking water
	18. Calculate water measurements

UNIT III: LAND MANAGEMENT

1. Terms and definitions
2. How soils are formed
3. Types of rocks
4. Weathering factors
5. Types of soils
6. Major soil texture classes
7. Composition of an average soil
8. Functions of organic matter
9. Horizons of a soil profile
10. Land capability classes
11. Soil testing
12. Major and minor plant nutrients
13. Nutrients in a fertilizer analysis
14. Soil survey reports
15. Types of erosion
16. Causes of erosion
17. Effects of erosion

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)
18. Contributors to erosion pollution	
19. Methods of controlling erosion on the farm	
20. Methods of controlling urban erosion	
21. Stewards of the soil	
22. Conservation Provisions of the 1985 Farm Bill	
23. Parts of a conservation plan	
24. Reclamation of mined lands	
25. Land management careers	
	26. Read a soil test report
	27. Complete a land use planning summary
	28. Read a soil survey map
	29. Read a conservation plan
	30. Take a lawn and garden soil sample
	31. Perform a soil test to determine organic matter
	32. Determine percent of soil particles

UNIT IV: AIR RESOURCE MANAGEMENT

1. Terms and definitions
2. Composition and percentages of air components
3. Air pollutants and health hazards associated with each
4. Environmental effects of air pollution
5. Indoor air pollution
6. Indoor air pollutants and descriptions
7. Air quality regulations

RELATED INFORMATION: What the Worker Should Know (Cognitive)

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

8. Methods of controlling motor vehicle emissions
9. Methods of controlling air pollution from industry and electric power generating plants
10. Progress made from 1976 to 1986 in controlling air pollution
11. Global considerations in air resource management
12. Careers in air resource management
13. Locate sources of air pollution in your area
14. Write a report on a global environmental problem related to air resource management
15. Collect and report results from air monitoring equipment

UNIT V: WILDLIFE MANAGEMENT

1. Terms and definitions
2. Food chain
3. Food web
4. Predator/prey relationship
5. History of wildlife
6. Federal legislation concerning wildlife
7. Types of birds
8. Small mammals and large mammals
9. Major fish species
10. U.S. endangered species
11. Dangers to wildlife populations
12. Agricultural practices that support wildlife

RELATED INFORMATION: What the Worker Should Know (Cognitive)

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

13. Wildlife activities that cause damage to agriculture
14. Ways to control wildlife damage problems
15. Public wildlife and private lands
16. Types of private wildlife production areas
17. Government agencies involved in wildlife management
18. Major private wildlife organizations
19. Careers in wildlife management
20. Discuss effects on a food chain when parts are removed
21. Create a food web
22. List fish and wildlife in your area
23. Identify wildlife you see in a certain time span
24. Compile a profile of a wildlife species

UNIT VI: WILDLIFE HABITATS

1. Terms and definitions
2. Components of a habitat
3. Objectives of wildlife habitat management
4. Habitat management principles
5. Common tools and techniques of habitat improvement
6. Actions taken to improve wildlife habitats
7. Causes of habitat destruction
8. Types of wildlife habitats

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)
9. Lakes, ponds, and pothole habitats	
10. River and stream habitats	
11. Wetland habitats	
12. Woodland habitats	
13. Rangeland habitats	
14. Farmland habitats	
15. Urban habitats	
	16. Layout and identify ways to improve a local habitat
	17. Identify ways to improve a wetland habitat
	18. Determine the carrying capacity of a pond
	19. Determine the carrying capacity of rangeland

UNIT VII: OUTDOOR RECREATION

1. Terms and definitions
2. Equipment and facilities needed for outdoor recreation activities
3. Skills and licenses needed for outdoor recreation activities
4. Major factors increasing the demand and participation in outdoor recreation
5. Other factors affecting current and future participation in recreation activities
6. Considerations people use in selecting an outdoor recreation area
7. Motivations for Americans to participate in outdoor recreation

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)
8. Agencies responsible for public lands, recreation areas, and employment in outdoor recreation	
9. Employment opportunities in outdoor recreation	
10. Business opportunities in outdoor recreation	
	11. Identify outdoor recreation activities and facilities available locally
	12. Make a presentation about outdoor recreation
	13. Interpret graphs on future trends in outdoor recreation
	14. Evaluate a local outdoor recreation site
	15. Plan and design a new outdoor recreation area
	16. Research local employment opportunities in outdoor recreation

UNIT VIII: FORESTRY

1. Terms and definitions
2. Main parts of a tree
3. Parts of the crown
4. Parts of the trunk
5. Types of roots
6. Ways trees are identified
7. Photosynthesis process
8. Growth of a tree
9. Classifications of trees
10. Common uses of trees
11. Benefits of forests to the environment

RELATED INFORMATION: What the Worker Should Know (Cognitive)	JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)
12. Government agencies involved in forestry	
13. Major forest regions of the continental United States	
14. Types of forest cuttings	
15. Ways that tree stands regenerate	
16. Forest measurements	
17. Measuring instruments used in forestry	
18. Forest enemies	
19. Causes of fire	
20. Types of forest fires	
21. Categories of forest fires	
22. Benefits of controlled burns	
23. Careers in forestry	
	24. Identify specific trees
	25. Determine the age of a tree
	26. Classify local trees
	27. Determine uses of wood and wood by-products
	28. Solve cord measurement problems
	29. Plant a bareroot tree
	30. Measure diameter of a tree
	31. Measure merchantable height of a tree

RELATED INFORMATION: What the Worker Should Know (Cognitive)

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

UNIT IX: ENERGY RESOURCES

1. Terms and definitions
2. Renewable and nonrenewable energy resources
3. Coal energy resources
4. Oil energy resources
5. Natural gas energy resources
6. Nuclear energy resources
7. Hydropower energy resources
8. Biomass energy resources
9. Solar energy resources
10. Wind energy resources
11. Geothermal energy resources
12. U.S. energy reserves
13. Percentages of oil resource use in the U.S.
14. Goals of energy conservation
15. Ways to conserve energy
16. Careers in energy resources
17. Discuss the effects of a Middle East oil embargo
18. Compare electric production from coal and nuclear fuel
19. Research and report on using agriculture products as alternative energy resources
20. Perform an energy audit of your home

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss preservation and conservation of natural resources, waste disposal, recycling, and local problems or events affecting natural resources. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to natural resources and conservation with the correct definitions.
2. Define natural resources.
3. Distinguish between renewable and nonrenewable natural resources.
4. Name the basic components of the physical environment.
5. Complete statements concerning the history of natural resources.
6. Explain the importance of natural resources.
7. Complete statements concerning conflicts in natural resource management.
8. List factors which harm natural resources.
9. Distinguish between preservation and conservation of natural resources.
10. List preservation activities.
11. List conservation activities.
12. Match categories of solid waste with the correct descriptions.
13. Select true statements concerning the composition of solid waste in a municipal landfill.
14. Complete statements concerning the methods of waste disposal.
15. Select true statements concerning waste reduction activities.
16. Distinguish between recyclables and nonrecyclables.
17. Match federal agencies responsible for natural resources with their descriptions.
18. List types of occupations in natural resources.

SPECIFIC OBJECTIVES

19. List ways of getting a job in natural resources.
20. List characteristics of a person working in natural resources.
21. Report on a local natural resource problem. (Assignment Sheet #1)
22. Report on a current event affecting natural resources. (Assignment Sheet #2)
23. Identify recycling centers in your area. (Assignment Sheet #3)
24. Determine what is recyclable. (Assignment Sheet #4)
25. Identify occupations of interest. (Assignment Sheet #5)

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and should be used with the following objectives:

TM 1 — Natural Resources - Renewable — Objective 3

TM 2 — Natural Resources - Nonrenewable — Objective 3

TM 3 — Basic Components of the Physical Environment — Objective 4

TM 4 — Types of Pollution — Objective 8

TM 5 — Solid Waste — Objective 13

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Discuss natural resources in your area.
2. Discuss local industries that use natural resources.
3. Have students list exhaustible and inexhaustible resources.
4. Have students prepare reports on a specific type of natural resource in the area.
5. Collect newspaper articles that discuss natural resources.
6. Choose a product and have students design their version of a machine that would recycle it. Have them explain how it works.
7. Separate garbage and have students determine what percent is paper, aluminum, food, plant material, plastic, metal, glass, and other.
8. Start a recycling club in your school.

SUGGESTED ACTIVITIES

9. Discuss local career opportunities in natural resources.

10. Have students research local firms involved with natural resources to find out what they do and whom they employ.

11. Have guidance counselor talk to students about education required for various careers in natural resources.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Camp, William G. *Managing Our Natural Resources.* Albany, NY: Delmar Publishers Inc., 1988.

B. Kircher, Harry B. *Our Natural Resources and Their Conservation*, 6th ed. Danville, IL: The Interstate Printers & Publishers, Inc., 1988.

C. *Applied Biology/Chemistry.* Waco, TX: Center for Occupational Research and Development, 1989.

D. *Earth's Threatened Resources.* Washington, DC: Editorial Research Reports, 1986.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Resource Directories. *Guide to Federal Jobs*, 2nd ed. Toledo, Ohio

B. Films and videotapes

1. *Problems of Conservation Series*

    a. *Soil*, 14 min.
    b. *Water*, 16 min.
    c. *Forest and Range*, 14 min.
    d. *Wildlife*, 13 min.
    e. *Our Natural Resources*, 11 min.
    f. *Air*, 15 min.
    g. *Minerals*, 17 min.

    Available from:

    Britannica Films and Video
    425 N. Michigan Avenue
    Chicago, IL 60611
    800/558-6968

SUGGESTED ACTIVITIES

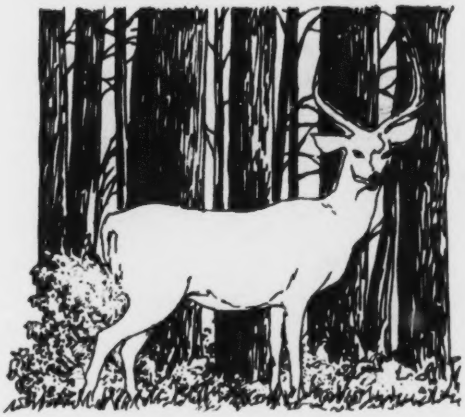
2. *Restoring the Environment.* 26 min., VHS or Beta. Discusses ways to correct environmental problems that technology has created. Available from:

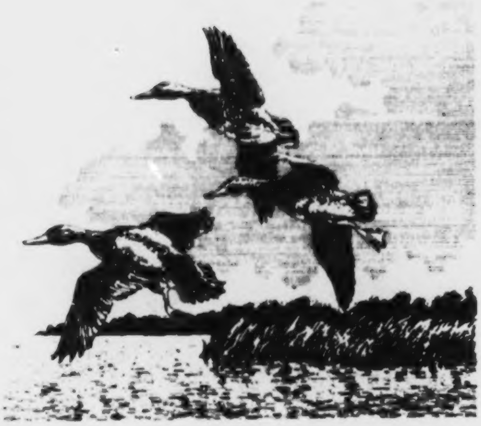
   Films for the Humanities and Sciences
   P.O. Box 2053
   Princeton, NJ 08543
   800-257-5126

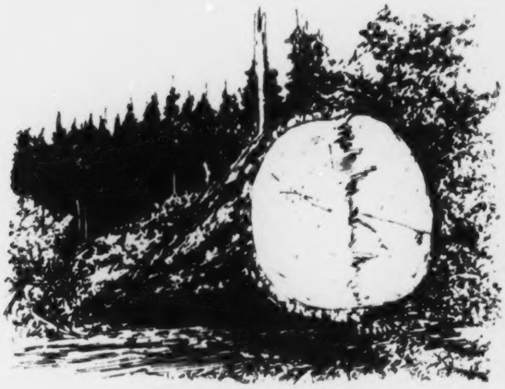
3. *Territory in Conflict.* 29 min. ½" or ¾" video. Presents both sides of a conflict between townspeople of Crested Butte, Colorado wanting to preserve their environment and AMAX, an international corporation, wanting to mine the molybdenum in the mountains overlooking the town. Award winner. Available from:

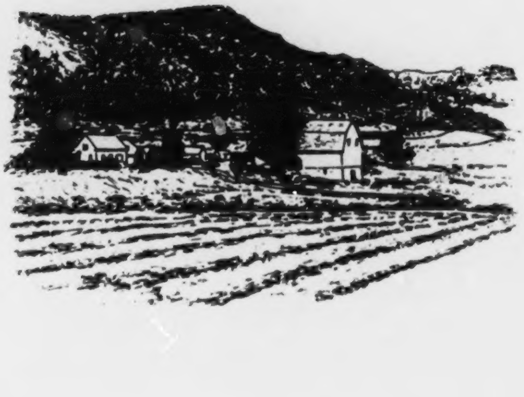
   Centre Productions, Inc.
   Distributed by Barr Films
   12801 Schabarum Ave.
   P.O. Box 7878
   Irwindale, CA 91706-7878
   818-338-7878

Natural Resources
-Renewable-

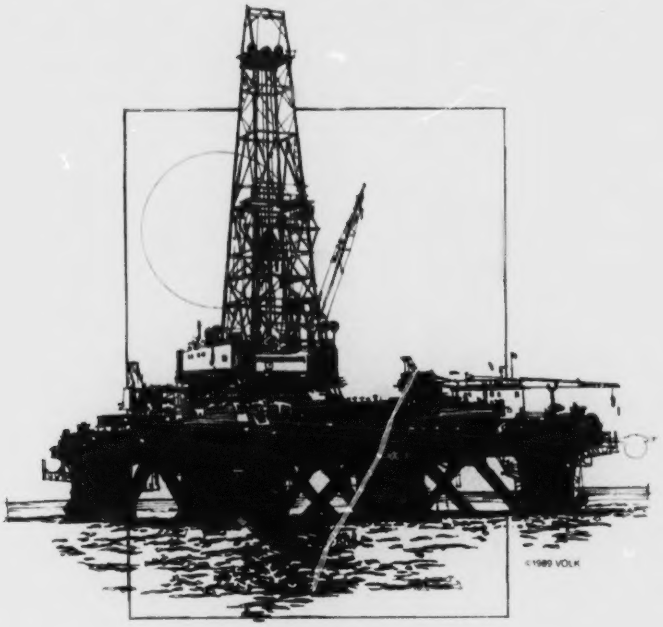


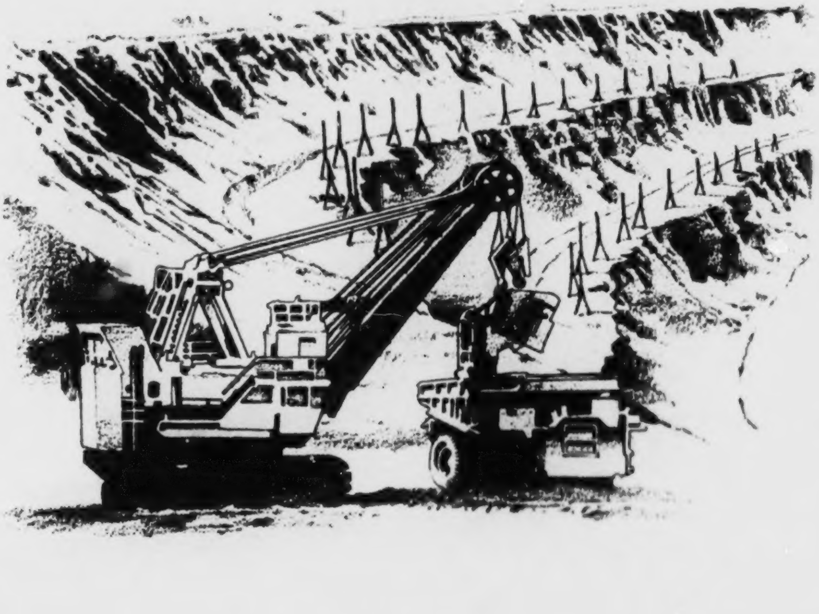




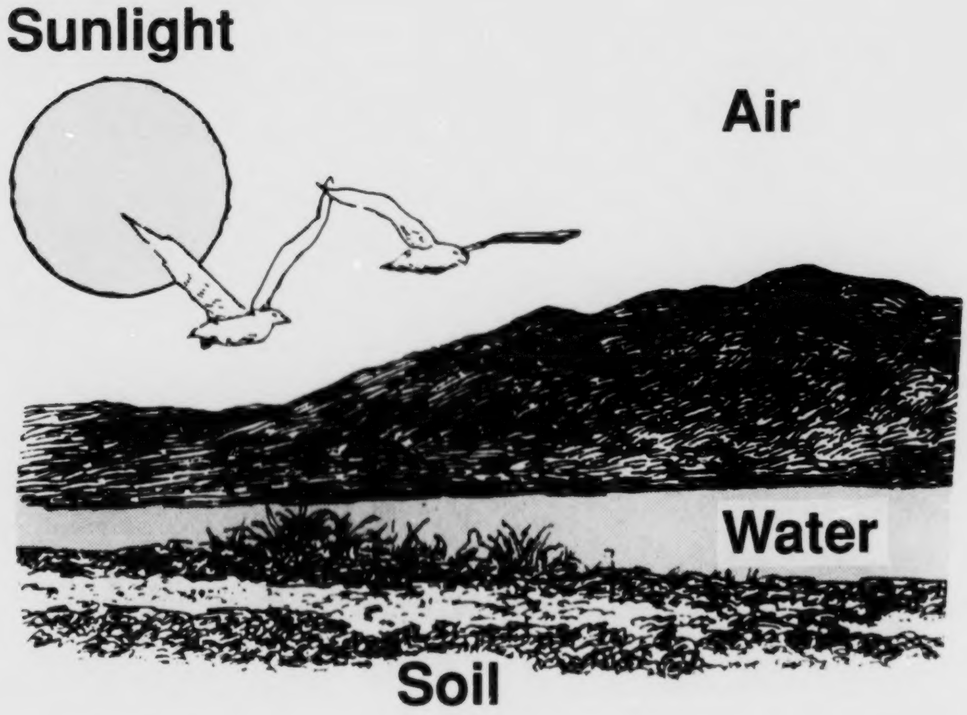


Natural Resources
-Nonrenewable-

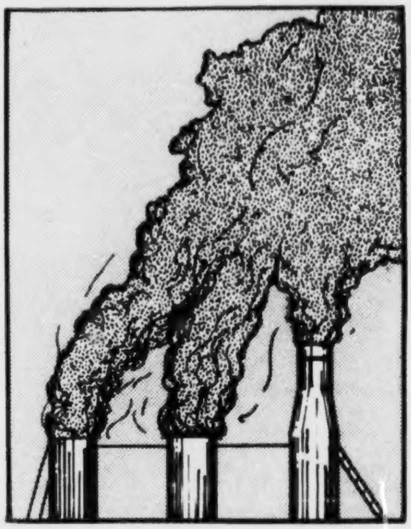




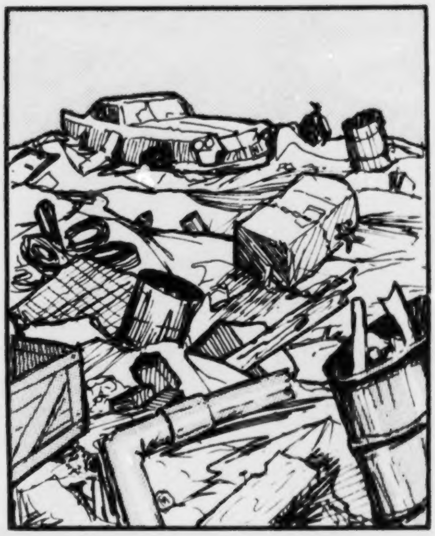
Basic Components of the Physical Environment


Sunlight
Air
Water
Soil

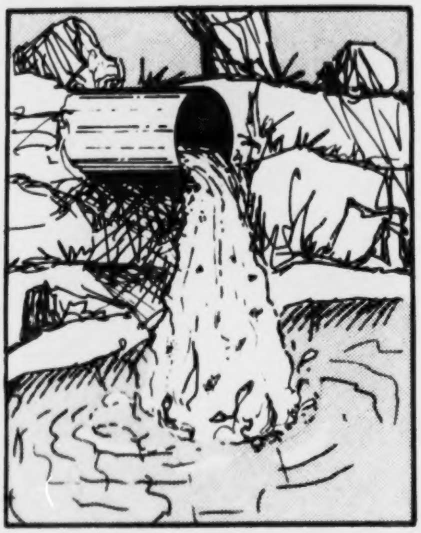
Types of Pollution



Air Pollution

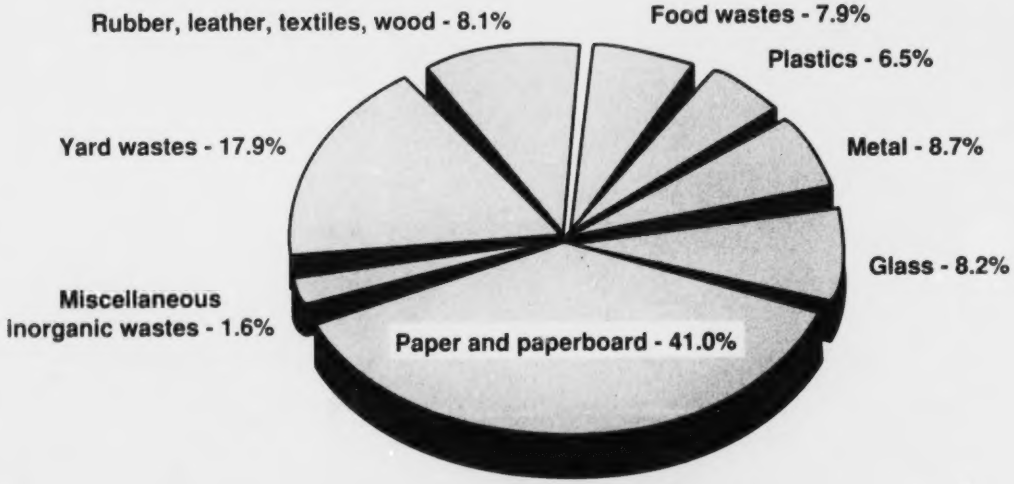


Land Pollution

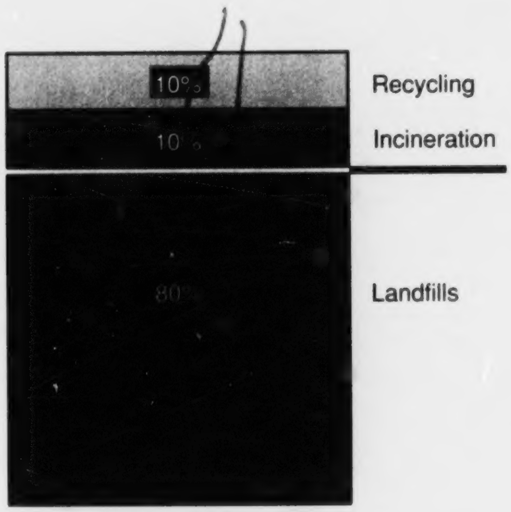


Water Pollution

Solid Waste



Composition of Municipal Waste



How U.S. Disposes of Its Solid Waste (1989)

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

INFORMATION SHEET

I. **Terms and definitions**

A. Abuse — To injure or damage

B. Biodegradable — A material that decomposes in the environment as a result of biological action (microorganisms)

(NOTE: Products vary in the amount of time they require to degrade, from a few weeks to thousands of years. However, many biodegradable products will never degrade without sunlight or oxygen which may be lacking in a landfill.)

C. Consumptive — Use of any resource in a way that harvests and uses (consumes) it

D. Degradation — Lowering the quality of a resource

E. Depletion — Using up the total quantity of a resource

F. Ecosystem — A unit of the environment comprising the interactions of all organisms and the physical components within a given area

G. Ecologist — A person who studies the relations between organisms and their environment

H. Endangered species — A species that is in immediate danger of extinction

I. Environmental impact — Changes in the environment caused by some form of management or mismanagement

J. Fossil fuels — Hydrocarbon compounds derived from the remains of organisms (plants and animals) buried millions of years ago

K. Global — Involving the entire world

L. Hazardous (toxic) waste — Waste that poses a serious threat to human health even at extremely low concentrations

M. Management — Skillful use of a resource

N. Misuse — To use incorrectly

O. Nonconsumptive — Use of a resource in a way that allows it to be renewed

P. Ozone (O_3) layer — Layer of the atmosphere that protects the Earth from the harmful ultraviolet radiation in sunlight

Q. Pollution — A reduction in the quality of the environment by the introduction of impurities

INFORMATION SHEET

R. Recycling — Transforming waste products into new products

S. Urbanization — Growth or expansion of cities

T. Waste — Useless, unwanted, or discarded material

II. **Definition of natural resources** — A source of wealth or revenue supplied by nature and used by humans

III. **Types of natural resources**

A. Renewable natural resources — Resources which can be replaced after they are used.

Examples:

1. Plants — Trees can be cut for lumber; then small seedlings can be planted to replace them. Grass can be cut for animal forage and replaced by nature.
2. Animals — Livestock, fish, and game animals can be used for food and replaced by reproduction and relocation.

   (NOTE: Although these can reproduce, they can become extinct if their natural cycles are severely damaged.)

B. Nonrenewable natural resources — Resources which cannot be replaced in a lifetime after they are used.

INFORMATION SHEET

Examples:

1. Fossil fuels — Formed by decaying vegetation.
2. Soil and other minerals such as sand, iron, lead, gold, and aluminum that are formed by different arrangements of atoms in the earth's crust.

   (NOTE: These can be depleted or degraded to the point of being unusable.)

IV. **Basic components of the physical environment**

A. Air

1. Is vital to plants and animals for respiration (oxygen/carbon dioxide exchange).
2. Is easily contaminated by pollutants from industry, automobiles, and dust from agriculture practices and other human activities.

B. Water

1. Is vital to all organisms.
2. Is contaminated by sewage, industrial waste, agricultural runoff, and municipal storm runoff.

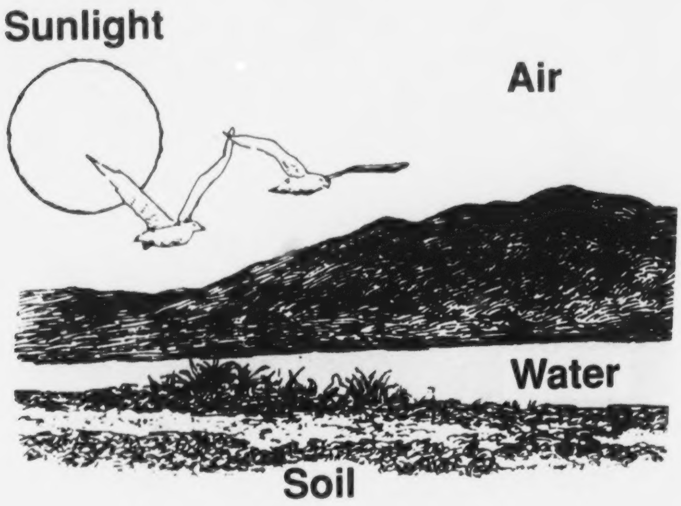
C. Soil

1. Is critical to all life because it supports vegetation which begins the food chain.
2. Forms very slowly and may take thousands of years to produce enough to sustain vegetation.
3. Is easily destroyed by wind, floods, and human activities such as farming, logging, mining, and construction when used improperly.

D. Sunlight

1. Is critical to all life which needs light and heat.
2. Is the basic source of all energy on Earth.

INFORMATION SHEET



V. **History of natural resources**

- A. Humans have always exploited natural resources.
- B. Industrial progress is built on the use and sometimes abuse of the many available natural resources.
- C. Originally, resources were so abundant that there was no need to conserve them.
- D. With the increase in population, some natural resources have become scarce.
- E. Proper management of resources must now replace exploitation.

VI. **Importance of natural resources**

- A. As human beings, we must have air, water, food, and shelter to survive.
- B. All of our basic needs are supplied by natural resources.
- C. Since many natural resources are unevenly distributed throughout the world, all nations must work together to share limited resources.
- D. Unlimited resources must not be damaged since they are shared by the entire world.
- E. The greatest threat to our survival is the depletion and degradation of our natural resources.

INFORMATION SHEET

VII. Conflicts in natural resource management

A. As the human population increases, demands for natural resources increase.

B. As natural resources are used, demands for their protection increase.

C. Conflicts between the use and preservation of natural resources are inevitable.

D. Continuous adjustments, trade-offs, and compromises between consumers and protectors of natural resources are necessary.

E. Examples of conflicts include:

   1. Wetlands needed by wildlife are drained and used for farming.
   2. Forests needed for recreation are cut by the timber industry.
   3. Hunting is resisted by animal rights activists.
   4. Many farming practices destroy wildlife habitats.
   5. Swamps supporting a diversity of plants and animals are drained so housing developments can be built.
   6. All-terrain vehicles used for recreation damage vegetation and landscapes and disrupt wildlife.
   7. Power generating plants contaminate the air of the people who use electricity.
   8. Pesticides and fertilizers increase crop yields but adversely affect surface and ground water.
   9. Vehicles needed to transport people to their work places increase air pollution.

F. Proper management of natural resources is critical to the health, prosperity, and lifestyle of the people who use them.

VIII. Factors which harm natural resources

A. Natural disasters

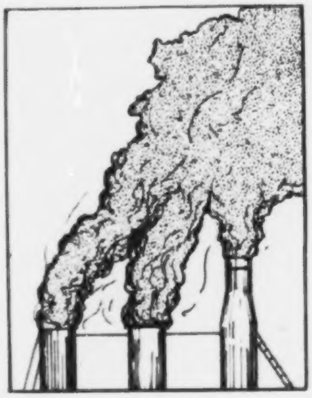
Examples:

- Droughts
- Volcanic eruptions
- Storms
- Floods

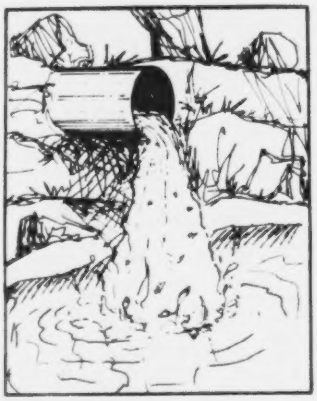
B. Air, water, and land pollution

Examples:

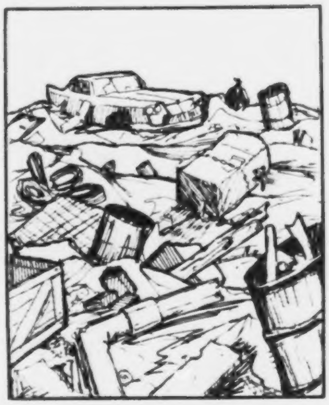
- Air pollution from automobile exhaust, industrial emissions, dust, and smoke
- Water pollution from domestic sewage entering waterways before proper treatment, and industrial waste improperly disposed of in landfills that moves down into the groundwater
- Land (soil) pollution from pesticides, toxic waste, acid rain, and disposal of solid waste on the land



Air Pollution



Water Pollution



Land Pollution

C. Urbanization — Affect natural resources by

- Destroying wildlife habitats
- Increasing domestic waste water volumes
- Creating industrial waste
- Contributing to air pollution

D. Agricultural practices

Examples:

- Improper use of pesticides
- Soil erosion
- Wasteful irrigation practices
- Clearing forestland and wetlands to create farmland

INFORMATION SHEET

E. Mining practices

Examples:

- Strip mining clears all surface vegetation
- Acid water drains from abandoned mines

F. Drilling practices

Examples:

- Introduce salt water into fresh water formations
- May result in oil spills and shipping accidents

IX. Preservation and conservation of natural resources

A. Preservation — Provides for the use and enjoyment of wilderness areas while leaving them unaltered for future generations.

B. Conservation — Promotes the use of natural resources in a manner which minimizes waste and maintains that resource for future use.

X. Preservation activities

A. Protect native animals and plants.

B. Protect migration routes and preserve suitable areas for migratory animals.

C. Manage harvested species (game animals) through the use of fishing and hunting regulations.

D. Identify and protect endangered species and the ecosystems on which they depend.

E. Protect natural landscapes.

F. Restore and replant land areas altered by human activity.

G. Prevent wetland drainage for domestic or industrial use.

H. Manage fires either by extinguishing or by allowing them to burn themselves out if they benefit the ecological plan of the area

I. Manage surface and ground water by controlling erosion and preventing pollution.

INFORMATION SHEET

J. Manage air quality to protect human health, vegetation, visibility, wildlife, and fish.

K. Manage soils to prevent soil erosion, physical removal, or contamination by waste disposal.

XI. Conservation activities

A. Air conservation activities

1. Since cars are major air polluters, keep your car tuned up, change fuel filters often, maintain emission control devices, and use unleaded gasoline.

2. Drive less, ride more. Use mass-transit, carpools, bicycles, or walk to work.

   (NOTE: The less you use your car, the less pollutants you put into the environment.)

3. Avoid using toxic chemicals released into the air such as oven cleaners and window cleaners. Instead use water and soap, baking soda, or vinegar.

4. Protect the environment from chlorofluorocarbons (CFCs) which deplete the ozone layer. Check your automobile for air-conditioning leaks which can release CFCs.

5. Plant trees. These use carbon dioxide and produce oxygen. Trees also help to purify the air.

B. Water conservation activities

1. Use low-flow shower heads. Short showers also use less water than baths.

2. Use faucet aerators for each sink.

3. Run washing machines and dishwashers only when they are full.

4. Do not let faucets run while hand-washing dishes, brushing teeth, or shaving.

   (NOTE: The average home faucet uses 5 gallons of water per minute!)

5. Water plants and lawns only as needed, and only in the morning to reduce evaporation.

6. Use fertilizers and pesticides conservatively to prevent groundwater contamination.

7. Fix leaky faucets or toilets.

INFORMATION SHEET

C. Soil (land) conservation activities

1. Keep soil covered with grass, ground covers, trees, and plants to prevent erosion.
2. Use recommended conservation practices such as crop rotation, contouring, and terracing to protect the soil's fertility and to prevent erosion.
3. Do not send toxic substances such as oils, pesticides, or batteries to the municipal landfill.

   (NOTE: Call your fire department about disposing of toxic waste.)

D. Energy conservation activities

1. Seal leaks and cracks around doors and windows with caulking and weather stripping.
2. Increase the insulation in your home to the maximum recommendation.
3. Drive fuel-efficient vehicles.
4. Use mass-transit, carpools, bicycles, or walk.

   (NOTE: This cuts down on the fuel used as well as decreases air pollutants.)
5. Set hot water heater at 120°F.
6. Use a cooler wash and cooler rinse in washing machines.
7. Turn down the heater at night.
8. Use fluorescent lights instead of incandescent.

   (NOTE: Fluorescents use only one-fourth of the energy.)
9. Turn lights and TV off when not using them.
10. Check for leaks around the refrigerator door. Also check the temperature. Set at 38°-42°.
11. Use high-efficiency appliances and those with energy-saving features.
12. Use microwave ovens and pressure cookers because they use less energy, and save time too.
13. Use alternative energies (solar, wind) where possible to lessen demand on nonrenewable energies (fossil fuels).

INFORMATION SHEET

14. Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.

    (NOTE: It uses less energy to recycle or reuse a product than to manufacture a new one from raw material.)

XII. Categories of solid waste

A. Agricultural — Solid waste from raising, slaughtering, and processing animal products and from orchards and field crops

B. Commercial — Waste from stores, offices, and other activities that do not actually turn out a product

C. Industrial — Waste from industrial processes and manufacturing

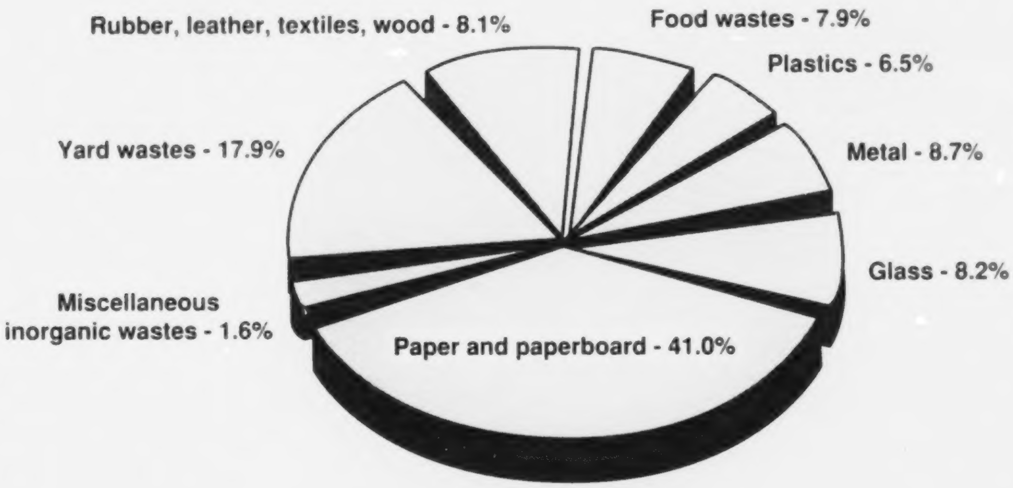
D. Institutional — Waste from educational, health care, and research facilities

E. Pesticide — Residue from the manufacturing, handling, and use of chemicals designed to kill plant and animal pests

F. Residential — Waste that usually originates in homes

(NOTE: Hazardous waste may originate at several of these sources. It must be separated from non-hazardous waste and be handled very carefully because it is toxic. It cannot be incinerated, and cannot go to ordinary municipal landfills.)

XIII. Composition of solid waste in a municipal landfill



INFORMATION SHEET

XIV. Methods of waste disposal

A. Landfills

1. Trash is dumped, and earth-moving equipment covers area with soil.
2. Currently 80% of trash goes to landfills.
3. Landfills are reaching capacity in many locations.

   (NOTE: In 1980 there were 18,000 landfills. In 1990 there were 6,500 with 2,000 of those projected to close by 1995.)

4. Fewer landfills are being built because land is not available (in highly populated areas), land is not suitable (too close to underground water or wetlands), or community groups oppose the landfill sites (the NIMBY—Not In My Backyard—Syndrome).
5. Improperly sited and maintained landfills contaminate the groundwater.
6. Properly designed landfills include impermeable liners, leachate collection systems, and groundwater monitoring devices.
7. Landfills will continue to be needed for wastes such as noncombustibles, nonrecyclables, and incinerator ash.

B. Incineration

1. Combustible trash is burned which produces heat and energy that can be used.
2. Currently 10% of trash is incinerated (with or without energy recovery).
3. Trash should be separated to only combustible trash.
4. Faulty incinerators create air pollution and toxic ash by-products, especially if toxic materials are not separated out.
5. Newer incinerators use advanced combustion systems, state-of-the-art air pollution controls, and restrictions on the kinds of waste that may be burned. These measures reduce air pollution significantly.
6. The advantage of incinerators is that they reduce the volume of refuse by 90%.

C. Recycling

1. This involves collecting, separating, processing, and marketing wastes such as glass, metals, and paper.
2. Currently 10% of trash is recycled.

INFORMATION SHEET

3. Recycling can divert potentially large volumes of trash from landfills and incinerators, and can help conserve natural resources such as trees and oil.

4. Materials that are recyclable must be separated before they can be recycled.

5. The challenge of making recycling economically feasible is to have a stable market where supply equals demand.

6. Technology for collecting and processing recyclables is improving.

   (NOTE: Plastics that used to be considered nonrecyclables are now being recycled.)

XV. Waste reduction activities

A. The first key to waste reduction is **source reduction** — eliminating waste before it happens.

   (NOTE: This has been compared to preventive medicine which stops the problem before it becomes a problem.)

   1. Source reduction involves minimizing the volume and toxicity of products at the source — from designers and manufacturers.

      Examples: Removing mercury from batteries, using less packaging, making products that can be recycled

   2. Source reduction also involves making goods more durable so that longer periods of time elapse before they are discarded.

      Examples: Radial tires that last 80,000 miles instead of 30,000; appliances that last 20 years or more

   3. As consumers we can encourage manufacturers to reduce waste by buying products that have less packaging, are free of toxins, are recycled or recyclable, and that are more durable.

B. The second key to waste reduction is **recycling**. A great deal of our waste can be recycled into new products.

C. What to buy:

   1. Products in concentrated forms

   2. Products in bulk

   3. Products made from recycled materials

      Examples: Newspapers and greeting cards printed on recycled paper

INFORMATION SHEET

4. Products that can be recycled

   Examples: Milk in bottles (that can be recycled) instead of cartons (that cannot)

5. Paper trash bags instead of plastic bags

6. Cloth napkins and towels instead of paper

7. Cloth diapers instead of disposables

8. Products that can be reused.

   Examples: Plastic dishes and cups for picnics instead of paper, ceramic coffee mugs instead of polystyrene

9. Rechargeable batteries

10. Products that last longer

    Example: Radial tires

D. What **not** to buy:

1. Over-packaged products

2. Throwaway items

   Examples: Plastic razors, nonrefillable ball point pens

3. Clothes requiring dry cleaning

   (NOTE: Waste products from the dry cleaning process are very toxic.)

4. Disposable diapers

5. Paper towels and napkins

6. Colored paper products

7. Excess food that will go to waste

XVI. Recyclables and nonrecyclables

A. Recyclables

1. Materials

   - Paper — Newspapers, corrugated boxes, office papers, mixed papers
   - Plastic — Milk, soft drink, and other containers
   - Glass — Bottles and jars

- Aluminum — Cans and other aluminum products
- Steel — Appliances and other steel products
- Scrap metal — Food cans, etc.
- Wood — Pallets, lumber, etc.
- Motor oils

2. Compost

- Leaves, grass, and brush
- Food wastes (vegetables - not meat)
- Some other organic materials, such as paper contaminated with food

B. Nonrecyclables

- Wastes heavily contaminated by food residues, household chemicals, or dirt
- Composite materials

  Examples: Aseptic boxes made of paper, foil, and adhesives, plastic-coated paper, furniture and appliances (other than their metal content)
- Miscellaneous inorganics, such as street sweepings

  (NOTE: At present, approximately 10 percent of all U.S. solid waste is recycled, but experts estimate that its full potential may be as high as 50 percent.)

XVII. Federal agencies responsible for natural resources

A. Department of the Interior

1. National Park Service — Manages more than 300 areas within the national parks system.
2. Fish and Wildlife Service — Helps protect the nation's birds, mammals, fish, and other wildlife.
3. Bureau of Land Management — Manages federal grasslands, prairie, desert, forest, and other open spaces of the nation's public lands.
4. Bureau of Indian Affairs — Works to promote the welfare of the nation's Native Americans and their lands.
5. U.S. Geologic Survey — Conducts surveys of the land and its resources and develops maps based on these surveys.

INFORMATION SHEET

6. Bureau of Mines — Works to ensure efficient mining, processing, use, and recycling of mineral resources.
7. Bureau of Reclamation — Works to develop water, land, energy resources, and other natural resources in the western United States.

B. Department of Agriculture

1. Forest Service — Works to manage and protect forestland and grassland while promoting their best use.
2. Soil Conservation Service — Helps prevent soil erosion from wind and water by working with local soil and water conservation districts and assisting in individual conservation plans and other conservation measures.
3. Agricultural Stabilization and Conservation Service — Administers programs with funding for agricultural conservation activities and administers farm programs

C. Environmental Protection Agency — Determines environmental standards and enforces federal environmental laws.

XVIII. Types of occupations in natural resources

A. Occupations that maintain and protect natural resources

Examples: Biologists, wildlife managers, foresters, soil conservationists

B. Occupations that collect and harvest natural resources

Examples: Miners, farmers, loggers

C. Occupations that make products from natural resources

Examples: Manufacturers, processors

D. Occupations that use products made from natural resources

Examples: Consumers

E. Occupations that convert natural resources to energy

Examples: Power plants, fuel companies

F. Occupations that provide services

Examples: Salespeople, truckers, engineers, teachers, technicians

INFORMATION SHEET

G. Occupations that enforce laws affecting natural resources

Examples: Rangers, agents, EPA officials

H. Occupations that dispose of waste

Examples: Solid waste managers, trash collectors, recycling center employees, environmental scientists

XIX. Getting a job in natural resources

A. Identify government agencies that have jobs of interest to you.

B. Become familiar with agencies involved with natural resources.

C. Request information and brochures related to your interest.

D. Get job-related experience as soon as possible.

E. Determine education required for various jobs.

F. Secure summer employment or volunteer work in a related area.

G. Get to know local individuals working in natural resources.

H. Take the Civil Service exam.

XX. Characteristics of a person working in natural resources

A. Desires to work outdoors.

B. Desires to work in agricultural related areas.

C. Has a concern for the environment.

D. Likes to interact with the natural environment.

E. Likes to work with people.

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

ASSIGNMENT SHEET #1 — REPORT ON A LOCAL NATURAL RESOURCE PROBLEM

NAME ______________________________ SCORE ____________________

EVALUATION CRITERIA

Criteria	Rating
Factor selected is appropriate	______
Report is thorough	______
Report is accurate	______
Neatness	______

Directions:

1. Survey your community or area.
2. Select a problem which is adversely impacting natural resources.

   Examples:

   - Air pollution
   - Water pollution
   - Soil erosion
   - Wildlife/habitat depletion
   - Loss of vegetation
   - Loss of wetlands
   - Solid waste

3. Research the problem, and then write a report containing the following information:
   a. Name of impacting factor
   b. Cause of impacting factor
   c. How it is affecting natural resources
   d. Solution to the problem
   e. Expected result if solution is implemented

   (NOTE: More than one factor may be used since they may act together. For example, soil erosion may cause muddy streams which affect fish species and production.)

4. The report should adequately cover the subject. Length may be specified by the instructor.

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

ASSIGNMENT SHEET #2 — REPORT ON CURRENT EVENTS AFFECTING NATURAL RESOURCES

NAME ______________________________ SCORE ____________________

EVALUATION CRITERIA

Criteria	Rating
Event selected is appropriate	______
Presentation is informative	______
Subject is covered well	______

Directions:

1. Collect current articles which identify factors affecting natural resources.
2. Evaluate the problem and any possible solution(s).
    a. What natural resources are affected?
    b. How are they being affected? (the problem)
    c. What is being done about it? (the solution)
    d. Is the solution effective? If not, what else could be done?
3. Give a five-minute oral presentation on that subject to the class.

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

ASSIGNMENT SHEET #3 — IDENTIFY RECYCLING CENTERS IN YOUR AREA

NAME ______________________________ SCORE ________________

EVALUATION CRITERIA	
Criteria	Rating
Assignment is neat and completed on time	______
Centers are listed	______
Their products are listed	______

Directions: Use the telephone book to make a list of recycling centers in your area. Call or visit them to determine the types of products that they recycle.

Recycling Centers	Products for Recycling
1.	
2.	
3.	
4.	
5.	

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

ASSIGNMENT SHEET #4 — DETERMINE WHAT IS RECYCLABLE

NAME ______________________________ SCORE ________________

EVALUATION CRITERIA

Criteria	Rating
Assignment is neat and completed on time	______
Information is correct	______

Directions: Using an assortment of material provided by your instructor, determine which items are recyclable. List the recyclable items below.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

ASSIGNMENT SHEET #5 — IDENTIFY OCCUPATIONS OF INTEREST IN YOUR AREA

NAME ____________________ SCORE ____________

EVALUATION CRITERIA

Criteria	Rating
Occupations listed are in natural resources	______
Five occupations are listed	______

Directions: Use the telephone book to make a list of natural resource businesses that interest you.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

TEST

NAME ________________________________ SCORE ________________

1. Match the terms on the right with the correct definitions.

    _____a. A material that decomposes in the environment as a result of biological action

    _____b. To injure or damage

    _____c. Transforming waste products into new products

    _____d. Growth or expansion of cities

    _____e. Layer of the atmosphere that protects the Earth from the harmful ultraviolet radiation in sunlight

    _____f. Hydrocarbon compounds derived from the remains of organisms buried millions of years ago

    _____g. A reduction in the quality of the environment by the introduction of impurities

    _____h. Lowering the quality of a resource

    _____i. Useless, unwanted, or discarded material

    _____j. Involving the entire world

    1. Abuse
    2. Biodegradable
    3. Degradation
    4. Depletion
    5. Ecosystem
    6. Environmental impact
    7. Fossil fuels
    8. Global
    9. Hazardous waste
    10. Ozone layer
    11. Pollution
    12. Recycling
    13. Urbanization
    14. Waste

2. Define natural resources. ____

    ____

    ____

3. Distinguish between the types of natural resources by placing an "R" next to renewable and an "N" next to nonrenewable.

    _____a. Resources that cannot be replaced in a lifetime after they are used such as fossil fuels

    _____b. Resources that can be replaced after they are used such as plants and animals

TEST

4. Name the four basic components of the physical environment.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

5. Complete the following statements concerning the history of natural resources by circling the correct words.

   a. Humans have always (conserved, exploited) natural resources.

   b. Originally, resources were so (abundant, scarce) that there was no need to conserve them.

   c. With the increase in population, some natural resources have become (abundant, scarce).

6. Explain the importance of natural resources.

   ____

   ____

   ____

7. Complete the following statements concerning conflicts in natural resource management by circling the correct words.

   a. As population increases, demands for natural resources (decrease, increase).

   b. As natural resources are used, demands for their protection (decrease, increase).

   c. Conflicts between the use and preservation of natural resources are (unlikely, inevitable).

   d. (Compromises, Stand-offs) between consumers and protectors of natural resources are necessary.

8. List four factors which harm natural resources.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

TEST

9. Distinguish between preservation and conservation of natural resources by placing an "X" next to the definition of preservation.

_____a. Promotes the use of natural resources in a manner which minimizes waste and maintains that resource for future use

_____b. Provides for the use and enjoyment of wilderness areas while leaving them unaltered for future generations

10. List five preservation activities.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

11. List two activities to conserve each of the following natural resources.

a. Air conservation

1) ____________________

2) ____________________

b. Water conservation

1) ____________________

2) ____________________

c. Soil conservation

1) ____________________

2) ____________________

d. Energy conservation

1) ____________________

2) ____________________

TEST

12. Match categories of solid waste with the correct descriptions.

_____a. Waste from stores, offices, and other activities that do not actually turn out a product

_____b. Waste that usually originates in homes

_____c. Waste from educational, health care, and research facilities

_____d. Solid waste from raising, slaughtering, and processing animal products and from orchards and field crops

_____e. Residue from the manufacturing, handling, and use of chemicals designed to kill plant and animal pests

1. Agricultural
2. Commercial
3. Industrial
4. Institutional
5. Pesticide
6. Residential

13. Select true statements concerning the composition of solid waste in a municipal landfill by placing a T or F next to the true or false statements.

_____a. The largest percentage of products in the municipal landfill is food waste.

_____b. Yard waste make up about 45% of a landfill.

_____c. Glass makes up about 8% of a landfill.

_____d. Paper products make up about 41%.

14. Complete statements concerning methods of waste disposal by circling the correct words.

a. Currently (10%, 50%, 80%) of trash goes to landfills.

b. Fewer landfills are being built because (community groups oppose the landfill sites, landfills are no longer needed).

c. Improperly sited and maintained landfills contaminate the (air, water).

d. Faulty incinerators create (air, water) pollution and toxic ash by-products.

e. The advantage of incinerators is that they reduce the volume of refuse by (30%, 90%).

f. Currently (10%, 50%, 80%) of trash is recycled.

TEST

15. Select true statements concerning waste reduction activities by placing a T or F next to the true or false statements.

_____a. Source reduction is eliminating waste before it happens.

_____b. Recycling helps to reduce waste.

_____c. We should buy disposable diapers, clothes requiring dry-cleaning, and colored paper products to reduce waste.

_____d. We should buy products in bulk, those made from recycled materials, and reusable products to reduce waste.

16. Distinguish between recyclables and nonrecyclables by placing an "X" next to the recyclables.

_____a. Glass

_____b. Aluminum

_____c. Leaves, grass

_____d. Waste contaminated with food residue

_____e. Plastics

_____f. Wood

_____g. Paper

_____h. Composite materials

_____i. Furniture

_____j. Street sweepings

17. Match the federal agencies responsible for natural resources with their correct descriptions.

_____a. Helps protect the nation's birds, mammals, fish, and other wildlife

_____b. Works to promote the welfare of the nation's Native Americans and their lands

_____c. Determines environmental standards and enforces federal environmental laws

_____d. Helps prevent soil erosion from wind and water

1. Agricultural Stabilization and Conservation Service
2. Bureau of Indian Affairs
3. Bureau of Land Management
4. Bureau of Mines
5. Bureau of Reclamation

TEST

_____e. Manages more than 300 acres within the national parks system

_____f. Works to ensure efficient mining, processing, use, and recycling of mineral resources

_____g. Manage federal grasslands, prairie, desert, forest, and other open spaces of the nation's public lands

_____h. Works to manage and protect forestland and grassland while promoting their best use

_____i. Conducts surveys of the land and its resources and develops maps based on these surveys

_____j. Works to develop water, land, energy resources, and other natural resources in the western United States

6. Environmental Protection Agency
7. Fish and Wildlife Service
8. Forest Service
9. National Park Service
10. Soil Conservation Service
11. U.S. Geologic Survey

18. List five types of occupations in natural resources.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

19. List three ways of getting a job in natural resources.

a. ____________________

b. ____________________

c. ____________________

20. List three characteristics of a person working in natural resources.

a. ____________________

b. ____________________

c. ____________________

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

21. Report on a local natural resource problem. (Assignment Sheet #1)

22. Report on a current event affecting natural resources. (Assignment Sheet #2)

23. Identify recycling centers in your area. (Assignment Sheet #3)

24. Determine what is recyclable. (Assignment Sheet #4)

25. Identify occupations of interest. (Assignment Sheet #5)

INTRODUCTION TO NATURAL RESOURCES AND CONSERVATION
UNIT I

ANSWERS TO TEST

1.

a.	2	f.	7
b.	1	g.	11
c.	12	h.	3
d.	13	i.	14
e.	10	j.	8

2. A source of wealth of revenue supplied by nature and used by humans

3. a. N
   b. R

4. a. Air
   b. Water
   c. Soil
   d. Sunlight

5. a. Exploited
   b. Abundant
   c. Scarce

6. Student's explanation should include the fact that natural resources are needed for our survival.

7. a. Increase
   b. Increase
   c. Inevitable
   d. Compromises

8. Any four of the following:

   a. Natural disasters such as fires, droughts, etc.
   b. Air, water, and land pollution from various sources
   c. Urbanization
   d. Agricultural practices such as improper use of pesticides, soil erosion, etc.
   e. Mining practices such as strip mining
   f. Drilling practices that may result in accident

9. b

ANSWERS TO TEST

10. Any five of the following:

    a. Protect native animals and plants.
    b. Protect migration routes and preserve suitable areas for migratory animals.
    c. Manage harvested species through the use of fishing and hunting regulations.
    d. Identify and protect endangered species and the ecosystems on which they depend.
    e. Protect natural landscapes.
    f. Restore and replant land areas altered by human activity.
    g. Prevent wetland drainage for domestic or industrial use.
    h. Manage fires either by extinguishing or by allowing them to burn themselves out if they benefit the ecological plan of the area.
    i. Manage surface and ground water by controlling erosion and preventing pollution.
    j. Manage air quality to protect human health, vegetation, visibility, wildlife, and fish.
    k. Manage soils to prevent soil erosion, physical removal, or contamination by waste disposal.

11. Any two for each of the following:

    a. Air conservation

        1) Since cars are major air polluters, keep you car tuned up, change fuel filters often, maintain emission control devices, and use unleaded gasoline.
        2) Drive less, ride more. Use mass-transit, carpools, bicycles, or walk to work.
        3) Avoid using toxic chemicals released into the air such as oven cleaners and window cleaners. Instead use water and soap, baking soda, or vinegar.
        4) Protect the environment from chlorofluorocarbons (CFCs) which deplete the ozone layer. Check your automobile for air-conditioning leaks which can release CFCs.
        5) Plant trees. These use carbon dioxide and produce oxygen. Trees also help to purify the air.

    b. Water conservation

        1) Use low-flow shower heads. Short showers also use less water than baths.
        2) Use faucet aerators for each sink.
        3) Run washing machines and dishwashers only when they are full.
        4) Do not let faucets run while hand-washing dishes, brushing teeth, or shaving.
        5) Water plants and lawns only as needed, and only in the morning to reduce evaporation.
        6) Use fertilizers and pesticides conservatively to prevent groundwater contamination.
        7) Fix leaky faucets or toilets.

ANSWERS TO TEST

c. Soil conservation

1) Keep soil covered with grass, ground covers, trees, and plants to prevent erosion.
2) Use recommended conservation practices such as crop rotation, contouring, and terracing to protect the soil's fertility and to prevent erosion.
3) Do not send toxic substances such as oil, pesticides, or batteries to the municipal landfill.

d. Energy conservation

1) Seal leaks and cracks around doors and windows with caulking and weather stripping.
2) Increase the insulation in your home to the maximum recommendation.
3) Drive fuel-efficient vehicles.
4) Use mass-transit, carpools, bicycles, or walk.
5) Set hot water heater at 120°F.
6) Use a cooler wash and cooler rinse in washing machines.
7) Turn down the heater at night.
8) Use fluorescent lights instead of incandescent.
9) Turn lights and TV off when not using them.
10) Check for leaks around the refrigerator door. Also check the temperature. Set at 38°-42°.
11) Use high-efficiency appliances and those with energy-saving features.
12) Use microwave ovens and pressure cookers because they use less energy, and save time too.
13) Use alternative energies (solar, wind) where possible to lessen demand on nonrenewable energies (fossil fuels).
14) Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.

12. a. 2
    b. 6
    c. 4
    d. 1
    e. 5

13. a. F
    b. F
    c. T
    d. T

14. a. 80%
    b. Community groups oppose the landfill sites
    c. Water
    d. Air
    e. 90%
    f. 10%

ANSWERS TO TEST

15.
a. T
b. T
c. F
d. T

16. a, b, c, e, f, g

17.
a. 7
b. 2
c. 6
d. 10
e. 9
f. 4
g. 3
h. 8
i. 11
j. 5

18. Any five of the following: (Students may list specific occupations.)

a. Occupations that maintain and protect natural resources.
b. Occupations that collect and harvest natural resources.
c. Occupations that make products from natural resources.
d. Occupations that use products made from natural resources.
e. Occupations that convert natural resources to energy.
f. Occupations that provide services.
g. Occupations that enforce laws affecting natural resources
h. Occupations that dispose of waste

19. Any three of the following:

a. Identify government agencies that have jobs of interest to you.
b. Become familiar with agencies involved with natural resources.
c. Request information and brochures related to your interest.
d. Get job-related experience as soon as possible.
e. Determine education required for various jobs.
f. Secure summer employment or volunteer work in a related area.
g. Get to know local individuals working in natural resources.
h. Take the Civil Service exam.

20. Any three of the following:

a. Desires to work outdoors.
b. Desires to work in agricultural related areas.
c. Has a concern for the environment.
d. Likes to interact with the natural environment.
e. Likes to work with people

21-25. Evaluated to the satisfaction of the instructor.

WATER RESOURCE MANAGEMENT
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the ground water/surface water relationship and the physical/chemical considerations necessary to manage this vital natural resource. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to water resource management with the correct definitions.
2. Select true statements concerning the history of water in the U.S.
3. Complete statements concerning water distribution.
4. List uses of water.
5. Complete statements concerning the hydrologic (water) cycle.
6. Complete statements concerning surface water.
7. Select true statements concerning ground water.
8. Describe the relationship between ground water and surface water.
9. Select true statements concerning water pollution.
10. Compare the state of the environment of 1960 and 1990.
11. Select true statements concerning hazardous/toxic waste.
12. Match federal legislation for environmental protection of water resources with their intended purposes.
13. Select true statements concerning watersheds.
14. Match water measurement terms with the correct definitions or equivalents.
15. List career opportunities in water resource management.
16. Survey your area to identify water pollution sources. (Assignment Sheet #1)
17. Evaluate your source of drinking water. (Assignment Sheet #2)
18. Calculate water measurements. (Assignment Sheet #3)

WATER RESOURCE MANAGEMENT
UNIT II

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These are included in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Hydrologic (Water) Cycle — Objective 5

TM 2 — Surface Water Contamination — Objectives 6, 8

TM 3 — Ground Water Contamination — Objectives 7, 8

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Integrate the following activities throughout the teaching of this unit:

1. Invite a representative of the State Water Resource Board to discuss water problems in your area.
2. Invite state or federal environmental representatives to discuss environmental water problems in your area.
3. Invite state health department representatives to discuss health-related water problems.
4. Discuss ways to conserve water in homes, on farms, or in your community.
5. Discuss ways to prevent water pollution.
6. Order HACH kits for testing home and school drinking water. (Assignment Sheet #2)

Ordering information:

HACH
P.O. Box 389
Loveland, CO 80539
Toll free number: 1-800-227-4224

SUGGESTED ACTIVITIES

HACH kit ordering information:

Parameter	Detection Limits	Number of tests	1990 Cost
Coliform	Present/absent	25	$10.00
Nitrate	0-10 PPM	50	45.00
Sulfate	0-80 PPM	100	33.00
	50-200 PPM	100	33.00
Phosphate	2-10 PPM	50	21.00
	0-4.5 PPM	50	25.00
Chlorides	0-100	100	26.00
	0-400	100	26.00

7. You may also wish to use HACH kits to test water quality in local streams and farm ponds.

    a. If streams are to be tested, find a point of pollution and measure above and below that point. (Sewage treatment plant discharges are good areas for investigation and should be analyzed for nitrates and phosphates.)

    b. If farm ponds are used, select a variety of pond locations. Analyze each of the ponds for nitrates and phosphates.

        1) Select a small pond which receives run-off from barnyards or feedlots.

        2) Select a similar pond that is isolated from barnyards and feedlots.

        3) Select a pond which receives run-off from irrigated or fertilized farmland.

        4) Select a pond that does not collect fertilizer during run-off periods.

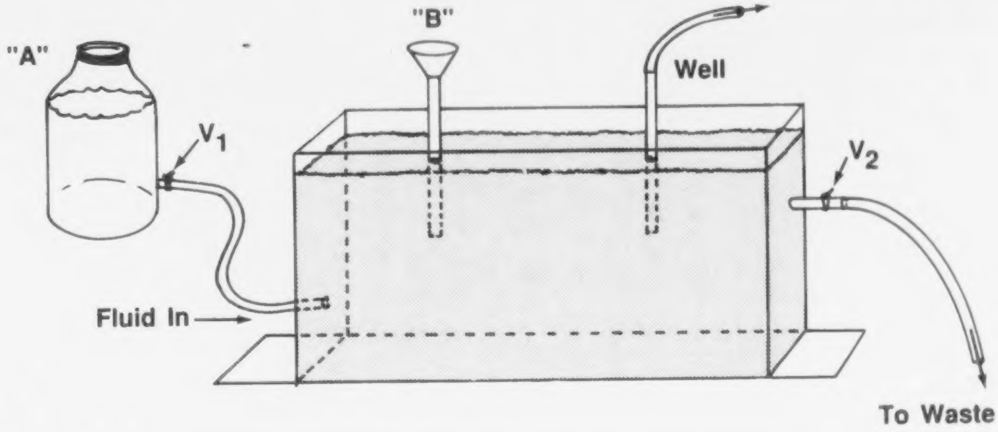
        (NOTE: Nitrates and phosphates in water in high concentrations reduce water quality and promote increased aquatic plant growth, especially algae. When algae cells die, oxygen is used in the decomposition which depletes the amount of oxygen available for fish. When plant growth is excessive, many fish will die from a lack of oxygen.)

8. Students may wish to have a special project on water resource management to qualify for an FFA Soil and Water Proficiency Award. Refer to the FFA *Agricultural Proficiency Award Handbook* for more details.

SUGGESTED ACTIVITIES

9. Build a physical flow model for understanding ground water flow and pollutant transportation.

   a. Using ½" or ⅜" piece of Plexiglas, construct an open top container measuring about 1 foot tall, 2 feet long, and 4 inches wide.



   b. Fill to within 2 inches of top with light colored sand.

   c. Fill with water to top of sand.

   d. Fill a 1 gal. (4 liter) or larger bottle (A) with water.

   e. Introduce dye in funnel "B" slowly until visible through glass. (This indicates a pollutant.) Dye can be a rhodamine tracer or other dye such as food color.

   f. When pollutant is visible, open valves V_1 and V_2 to adjust flow through model from left to right.

   g. The pollutant (or contaminant) can now be followed visually through the model.

   h. Periodic "well" samples can be collected to detect pollutant.

   (NOTE: Many variations can be used with this model such as pollutants can be poured directly on sand to duplicate a toxic waste dump.)

SUGGESTED ACTIVITIES

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Trieff, Norman M. *Environment and Health.* Ann Arbor, MI: Science Publishers, 1980.

B. Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources.* Albany, NY: Delmar Publishers, Inc., 1988.

C. Newport, Bob D. *Salt Water Intrusion in the United States.* Springfield, VA: National Technical Information Service, 1987.

D. Moran, Joseph M., et. al. *Introduction to Environmental Science.* New York: W. H. Freeman and Company, 1980.

E. Newport Bob D. *State-of-The-Art: Sand and Gravel Industry in The United States.* Washington, D.C.: National Environmental Research Center, Office of Research and Development.

F. U.S. Environmental Protection Agency. *Environmental Progress and Challenges.* Washington, D.C.: Public Information Center, Office of Policy and Planning, August 1988.

SUGGESTED SUPPLEMENTAL RESOURCES

A. *The Killing Ground.* © 1979. 52 min. 16 mm or video. Deals with toxic chemical wastes through four case studies. Produced by ABC News Closeup.

B. *Water: A Clear and Present Danger.* © 1983. 26 min. 16 mm or video. Discusses ground water contamination. Produced by ABC News Closeup.

A and B are available from:

MTI Film and Video
Distributed by Coronet/MTI Film & Video
108 Wilmot Road
Deerfield, IL 60015
800-621-2131

SUGGESTED SUPPLEMENTAL RESOURCES

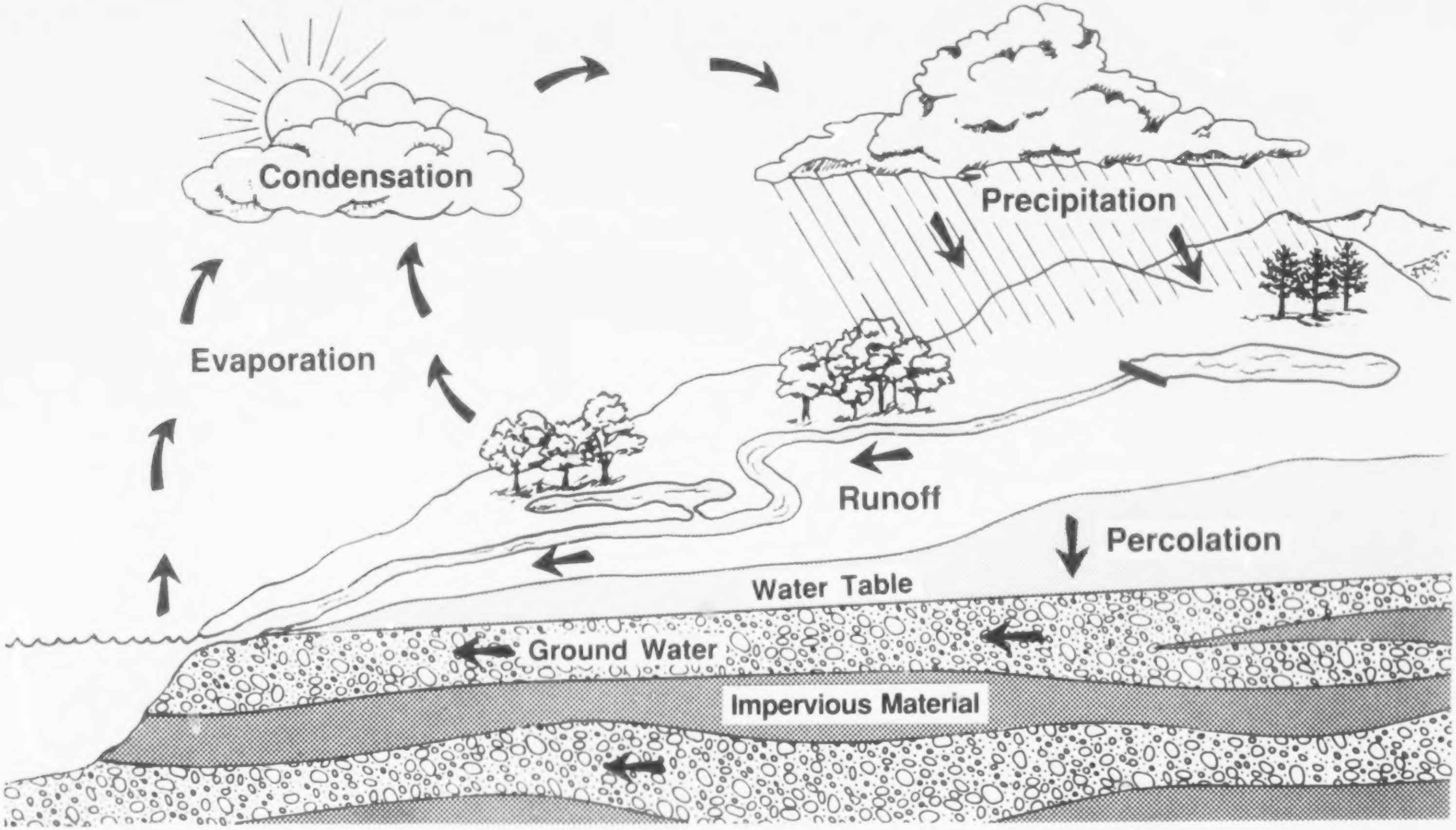
C. *Fit to Drink*. 20 min. VHS or Beta. Traces the water cycle. Available from:

Films for the Humanities and Sciences
P.O. Box 2053
Princeton, NJ 08543
800-257-5126

D. *Acid Rain*. 17 min., 1984. Discusses environmental and health concerns about acid rain and work being done to find solutions. Shows experiment of producing acid rain in a laboratory. Available from:

FilmFair Communications
10621 Magnolia Boulevard
North Hollywood, CA 91601
818-985-0244

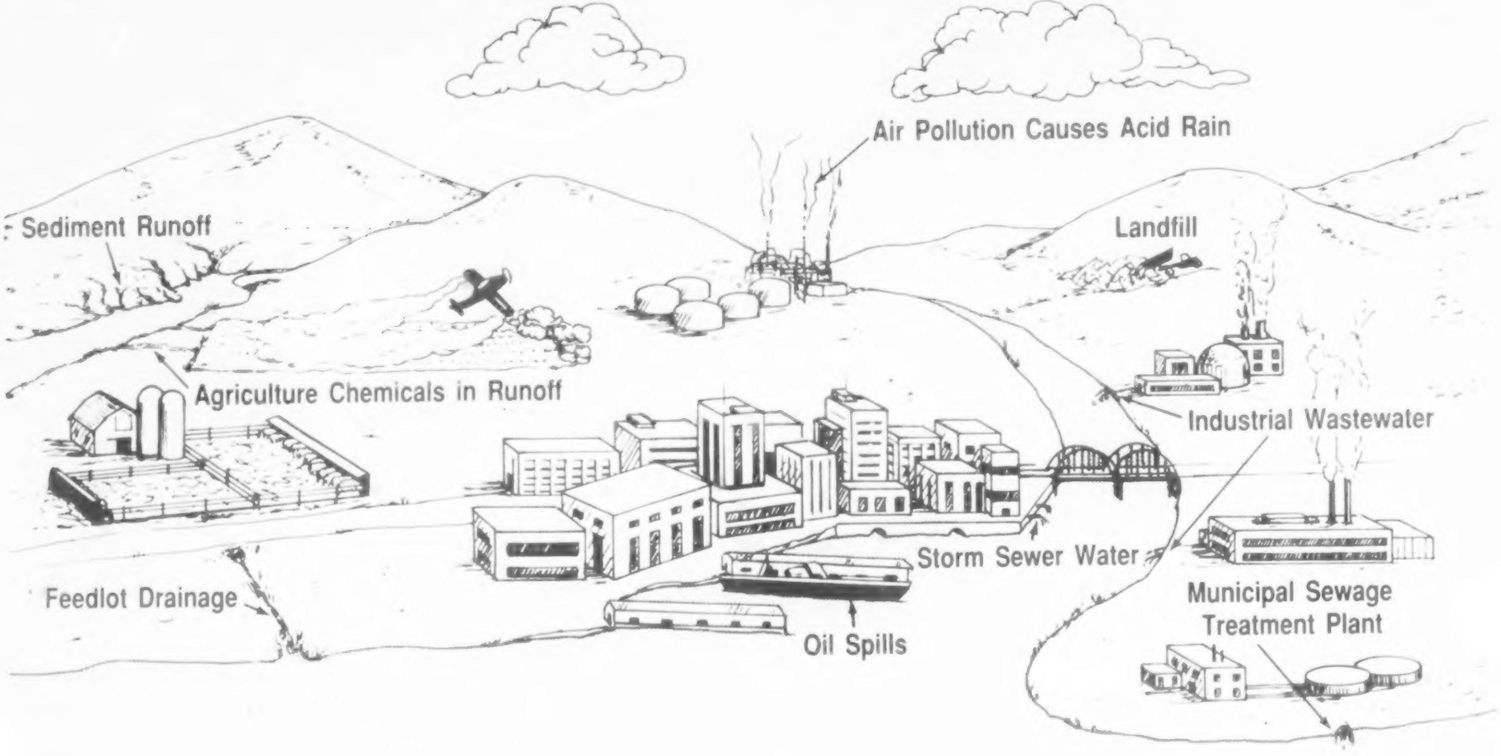
Hydrologic (Water) Cycle


Condensation
Precipitation
Evaporation
Runoff
Percolation
Water Table
Ground Water
Impervious Material

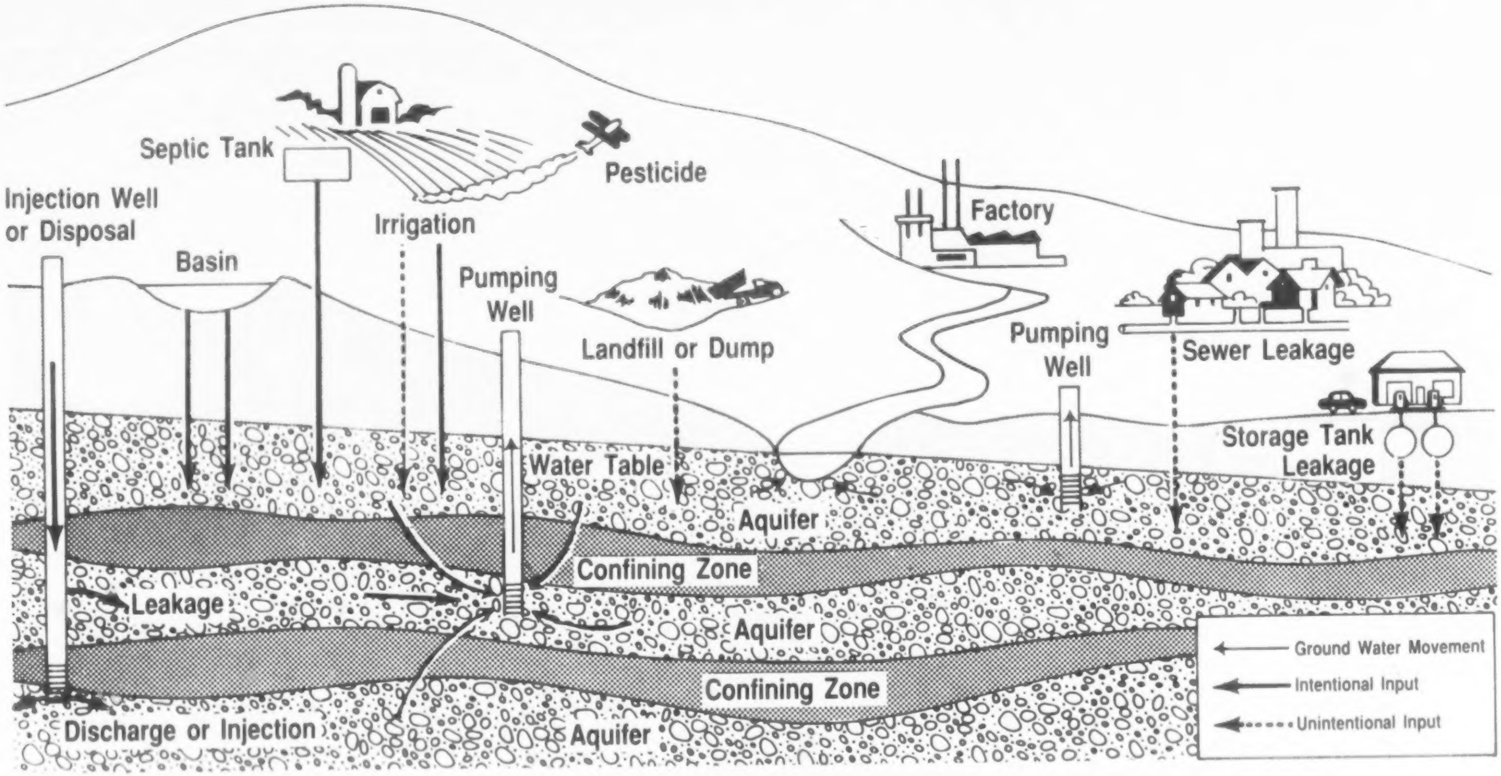
TM 1

NR-63

Surface Water Contamination


Air Pollution Causes Acid Rain
Sediment Runoff
Landfill
Agriculture Chemicals in Runoff
Industrial Wastewater
Storm Sewer Water
Feedlot Drainage
Municipal Sewage Treatment Plant
Oil Spills

Ground Water Contamination


Septic Tank
Pesticide
Injection Well
or Disposal
Irrigation
Factory
Basin
Pumping
Well
Landfill or Dump
Pumping
Well
Sewer Leakage
Storage Tank
Leakage
Water Table
Aquifer
Confining Zone
Leakage
Aquifer
Confining Zone
Discharge or Injection
Aquifer
Ground Water Movement
Intentional Input
Unintentional Input

Courtesy of U.S. Environmental Protection Agency

WATER RESOURCE MANAGEMENT
UNIT II

INFORMATION SHEET

I. **Terms and definitions**

A. Aquifer — Sand, gravel, or rock formation found below the earth's surface which is saturated with water

B. Ground water — Water found below the earth's surface

C. Ground water recharge — Water which seeps through the earth's surface and into the ground water aquifers

D. Hazardous/toxic waste — Waste that poses a serious threat to human health even at extremely low concentrations

E. Hazardous waste site — A location where hazardous waste poses a potential threat to the environment

F. Heavy metals — Metallic elements with high molecular weights; generally toxic to plant and animal life

Examples: Arsenic, cadmium, chromium, lead, mercury

G. Hydrologic cycle — Continuous circulation of water between the oceans, atmosphere, and the earth's surface

H. Industrial waste — Waste generated by industries

I. Municipal waste — Waste from cities, primarily sewage

J. Nonpoint source pollution — Pollution which enters the environment from a wide area

K. Pesticide — A chemical used to kill or control pests

L. Point source pollution — Pollution which can be traced to a point of discharge

M. Septic system — A waste treatment system used primarily in rural areas or where city sewer lines do not exist

N. Surface water — Water visible on the earth's surface

O. Water pollution — Water which is made chemically, biologically, or physically impure or unfit for use

P. Watershed — The total drainage area where water flows to a common point

Q. Water vapor — Water which has evaporated and is suspended in the air

INFORMATION SHEET

II. History of the importance of water

A. As the United States was settled, the availability of water was a prime concern because water is critical to the survival of all organisms.

B. Major population centers were located on rivers and lakes.

C. Water wheels were used to harness water's power.

Examples: Grinding corn and wheat, generating electricity

D. Waterways were used for transportation.

E. New industries that formed required large quantities of water.

F. Clean water has always been required for human consumption, agriculture, and fish and wildlife.

G. Water has been used extensively as an economic and recreational resource.

H. Historically, water has always been a vital natural resource.

III. Water distribution

A. Water covers 70% of the earth's surface.

B. 97% of surface water is salt water contained in the oceans.

C. 2% of surface water is contained in polar ice caps and glaciers.

D. 1% of the earth's fresh water is available for human consumption.

E. 97% of fresh water in the United States is contained underground in aquifers.

F. 3% of fresh water in the United States exists in streams and lakes.

G. The volume of ground water in the U.S. that is economically recoverable is equal to 9 times the volume of the Great Lakes.

IV. Uses of water

A. Domestic (cooking, drinking, and sanitation in homes)

B. Agricultural (livestock and crop irrigation)

C. Industrial

D. Business

E. Fish and wildlife habitats

F. Recreation

INFORMATION SHEET

V. Hydrologic (water) cycle

A. Water exists in three forms.

1. Liquid — In streams, lakes, and ground water aquifers.

2. Solid — In polar ice caps, glaciers, and frozen lakes.

3. Vapor — Water which has evaporated and is suspended in the atmosphere.

B. The total volume of water on earth remains constant.

C. Water continuously moving between the oceans, atmosphere, and surface water bodies constitutes the hydrologic cycle.

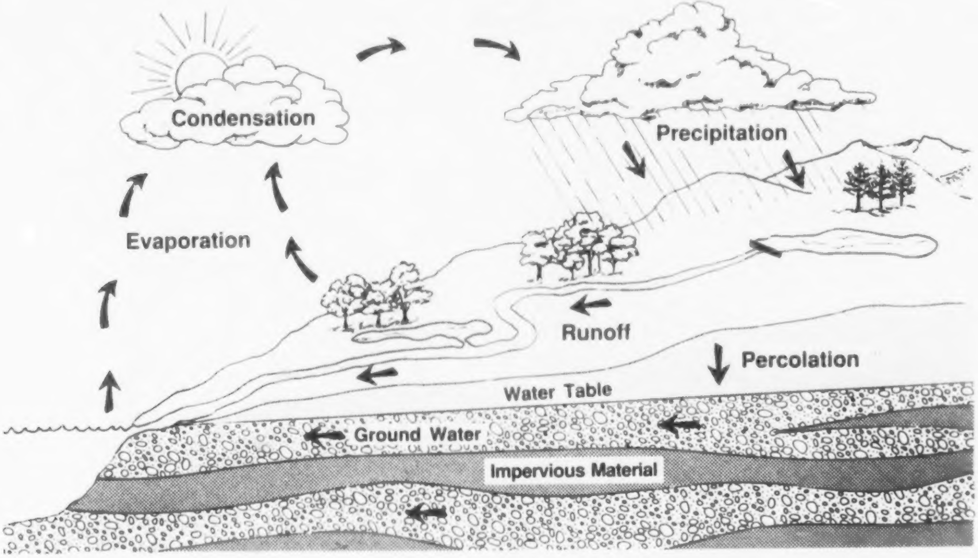
1. Water from surface water bodies and plants changes from liquid to water vapor (*evaporation*).

2. Water vapor changes to liquid as it is cooled in the atmosphere (*condensation*).

3. Condensed water falls to the earth as rain or ice (*precipitation*).

4. Water forms streams and rivers on the earth's surface (*runoff*), or water infiltrates the soil (*percolation*), supplying moisture for root systems and recharging ground water aquifers.

D. The hydrologic cycle is responsible for restoring water supplies which are lost to evaporation, runoff, and human use.


Condensation
Precipitation
Evaporation
Runoff
Percolation
Water Table
Ground Water
Impervious Material

INFORMATION SHEET

VI. Surface water

A. Surface water is water visible on the earth's surface.

Examples:

- Streams
- Farm ponds
- Lakes
- Rivers
- Oceans
- Wetlands
- Swamps
- Estuaries

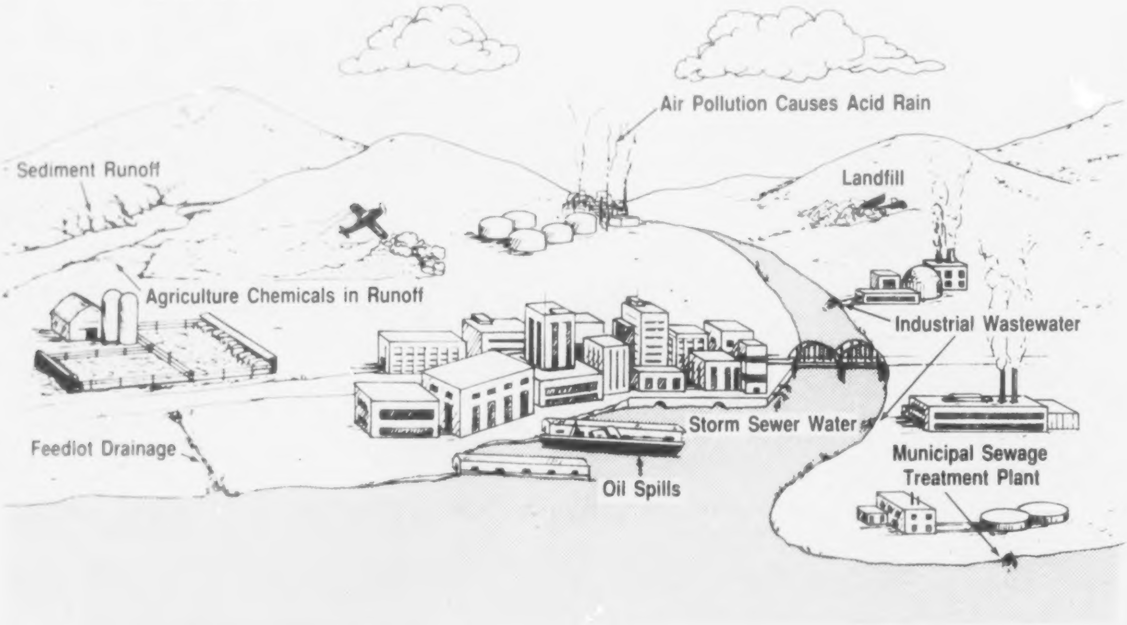
B. Surface water is used extensively without treatment.

C. Surface water must be treated before it can be used for domestic consumption and industrial processes.

D. Drinking water supplied to half of all Americans comes from surface water.

E. Surface waters are easily contaminated by human activities.

Examples:


Air Pollution Causes Acid Rain
Sediment Runoff
Landfill
Agriculture Chemicals in Runoff
Industrial Wastewater
Storm Sewer Water
Feedlot Drainage
Municipal Sewage Treatment Plant
Oil Spills

F. Since quantities of surface waters are limited, their uses must be regulated and conserved.

INFORMATION SHEET

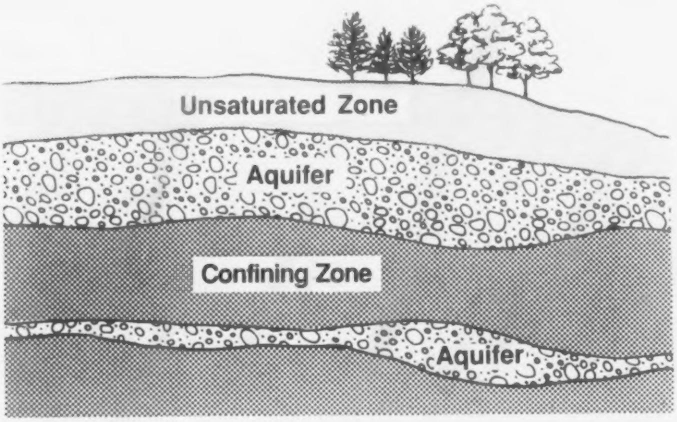
VII. Ground water

A. Ground water is water which is found below the earth's surface.

B. Ground water aquifers are sand, gravel, and rock formations below the earth's surface which are saturated with water.

   1. Aquifers are located a few feet to several hundred feet below the earth's surface.

   2. Aquifers vary in thickness from a few feet to several hundred feet.



C. Wells are drilled into aquifers to bring water to the surface where it can be used.

D. Half of all Americans and 95 percent of rural Americans use ground water for drinking water.

E. Contrary to common belief, ground water does not exist as rivers and lakes beneath the earth's surface.

F. The area between the earth's surface and the top of the aquifer is the unsaturated zone.

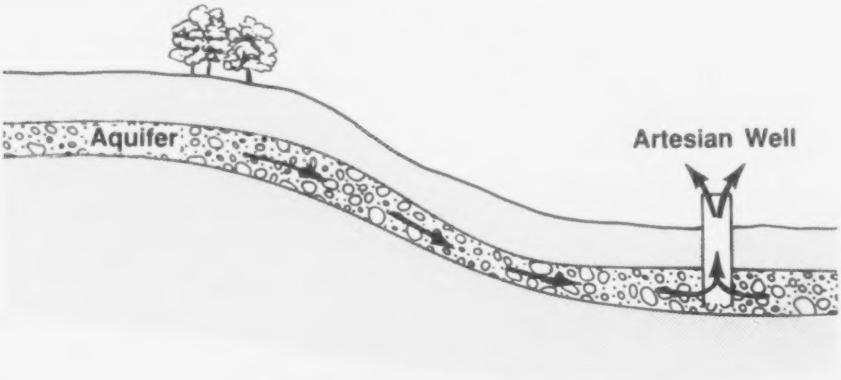
   1. The unsaturated zone is composed of various soil types.

   2. The unsaturated zone contains moisture but is not saturated.

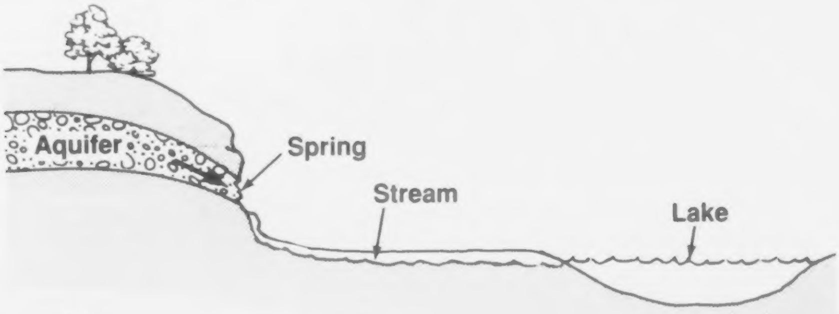
   3. The ground water aquifers are recharged (replenished) by surface water penetrating the unsaturated zone.

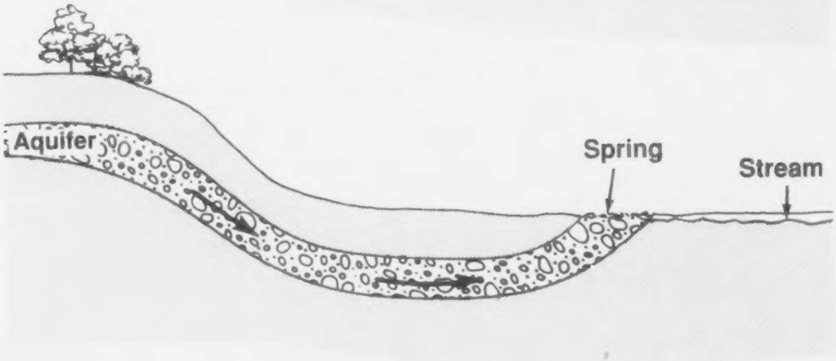
INFORMATION SHEET

G. Artesian wells are created when aquifer elevations are higher than the top of the well drilled into the aquifer.


Aquifer
Artesian Well

H. Springs exist where aquifer elevations are higher than the spring outlet.


Aquifer
Spring
Stream
Lake

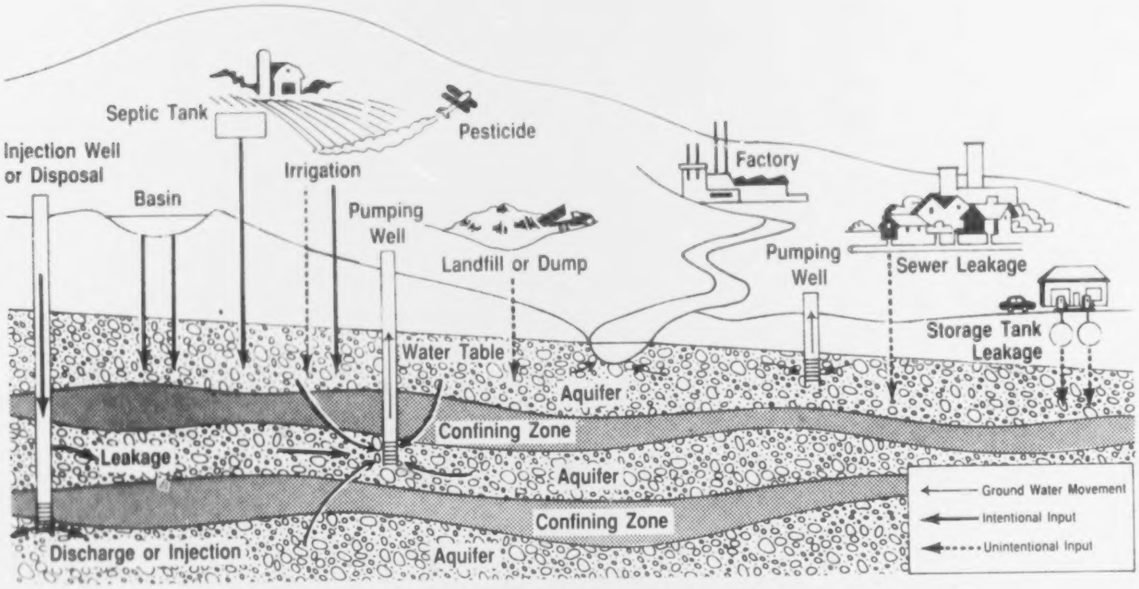

Aquifer
Spring
Stream

I. Ground water contained in aquifers generally moves very slowly from a few inches to a few feet per day.

INFORMATION SHEET

J. Ground water can be easily contaminated by human activities.

Examples:


Septic Tank
Pesticide
Injection Well or Disposal
Basin
Irrigation
Pumping Well
Factory
Landfill or Dump
Pumping Well
Sewer Leakage
Storage Tank Leakage
Water Table
Aquifer
Confining Zone
Leakage
Aquifer
Confining Zone
Discharge or Injection
Aquifer
Ground Water Movement
Intentional Input
Unintentional Input

Courtesy of U.S. Environmental Protection Agency

K. Ground water supplies are limited.

1. Ground water use must be regulated and conserved.
2. Ground water resources must be protected from contamination.

VIII. Ground water and surface water relationship

A. Ground water and surface water are intimately related.

B. Changes in surface water quality or quantity will affect ground water quality and quantity.

C. Changes in ground water quality or quantity will ultimately affect surface water.

D. Ground water supplies the base flow for all streams and rivers.

E. During periods of high river and stream elevations, surface water will enter ground water formations.

INFORMATION SHEET

IX. Water pollution

A. Water pollution is defined as water which is made chemically, biologically, or physically impure or unfit for use.

B. Historically, water pollution has caused serious epidemics and health problems in the United States.

Examples: Cholera, typhoid, infectious hepatitis, heavy metal poisoning, dysentery

C. Many municipal water supplies using surface water were often contaminated.

D. Rural water wells were often contaminated by livestock and human waste.

E. Most epidemic sources of biological pollution were identified and eliminated in the mid-1900's.

F. As biological epidemics decreased, chemical pollution of water resources increased.

G. Chemical pollutants are created as by-products of manufacturing, waste from industrial processes, agricultural chemicals and fertilizers, and domestic waste disposal practices.

H. Pollutant origin can be generally divided into two categories:

1. Point source — Pollution which can be traced to a point of discharge such as a drain pipe from an industry or sewage treatment plant.
2. Nonpoint source — Pollution from a large area such as soil erosion from construction sites, pesticides, fertilizers, and animal waste from agricultural practices, and drainage from mining practices.

X. Comparison of the environment — 1960 and 1990

A. State of the environment — 1960

1. By 1960, surface waters and ground waters were severely polluted.
2. Pollution of water in the Great Lakes had reduced or eliminated major fish species.
    a. Untreated sewage from large population centers entered the Lakes.
    b. Industrial waste was released directly into the Lakes or tributaries.

INFORMATION SHEET

3. Coastal waters were placed off-limits to fishing.

    a. Pollutants from industry, refineries, and agriculture had contaminated the waters and bottom sediment.

    b. Municipal waste from sewage treatment plants contained viruses and bacteria which entered the food chain.

    c. Fish and shellfish were unfit for human consumption.

4. Streams and major rivers were polluted by raw sewage and untreated industrial waste.

5. Sediments entering streams increased turbidity and covered spawning beds with silt, critically reducing fish numbers and species.

    a. Lumber companies removed forest next to streams promoting erosion.

    b. Mining companies removed surface vegetation and abandoned surface mines creating erosion avenues.

    c. Construction of roads, businesses, and residential areas created areas of soil instability.

6. Wetlands, which provide a diverse and prolific ecosystem, were destroyed.

    a. By 1960, over 50% of the wetlands in the U.S. had been converted to other uses. Wetlands were drained and converted to agriculture, industrial, or residential areas.

    b. By 1960, the rate of wetland loss was 500,000 acres annually.

7. Ground water pollution had been detected in every state. Contamination sources included:

    a. Nitrates and pesticides from agricultural areas

    b. Septic systems

    c. Contaminated surface impoundments

    d. Leaking underground and surface storage tanks

    e. Hazardous waste disposal sites

INFORMATION SHEET

B. State of the environment — 1990

1. The Environmental Protection Agency, along with other federal agencies, state environmental agencies, environmental groups, and concerned citizens, have made significant progress in restoring water quality.
2. Waste discharges from industry are regulated and enforced.
3. Municipal sewage treatment plants no longer release untreated waste to the environment.
4. Dumping of waste in the ocean is regulated.
5. Pesticides are now classified and their use is regulated.
6. Safe limits on chemicals in drinking water have been set.
7. Transport of hazardous chemicals is regulated.
8. Storage and disposal of hazardous waste is regulated.
9. Funds have been provided for the cleanup of existing hazardous waste sites.
10. Sediment from mining operations and lumber mills are controlled.
11. Wetlands are better protected from destruction and pollution.
12. Ground water resources are now better protected from sources of pollution.

XI. Hazardous/toxic waste

A. Hazardous or toxic waste is waste that poses a serious threat to human health, even at extremely low concentrations.

B. Improper hazardous waste disposal is a serious threat to water resources.

C. Hazardous waste is generated by:

1. Petroleum and petrochemical plants
2. Fertilizer producers
3. Metal refineries
4. Electroplating industries
5. Mining industries
6. Plastics manufacturers

INFORMATION SHEET

7. Pharmaceutical companies

8. Nuclear weapons systems and power plants

D. Until 1975, open dumps were used to dispose of most hazardous waste.

E. The main objective of the Resource Conservation and Recovery Act of 1976 was to regulate the disposal of hazardous waste.

F. Actual or potential sources of water resource contamination include: (1988 EPA figures)

1. 29,000 hazardous waste sites

2. 180,000 surface pits used for waste disposal

3. 500 hazardous waste land disposal facilities

4. 16,000 municipal landfills

5. 5-6 million underground storage tanks (hundreds of thousands are estimated to be leaking.)

6. Millions of tons of agricultural pesticides and fertilizers are applied annually.

G. Major environmental concerns are for man-made chemicals found in:

- Plastics
- Solvents
- Pesticides
- Paints
- Dyes
- Varnishes
- Ink

H. Health problems associated with hazardous waste contamination include cancer, brain and nerve damage, birth defects, and miscarriages.

(NOTE: One of the greatest concerns about toxic chemicals is that they stay in the body so long.)

INFORMATION SHEET

XII. Federal legislation for environmental protection of water resources

1970	National Environmental Policy Act	Requires environmental impact statements for all projects affecting the environment
1972	Clean Water Act	Regulates discharges from industry and sewage treatment plants
1972	Marine Protection Research and Sanctuaries Act	Regulates ocean dumping
1972	Ports and Waterways Safety Act	Regulates oil transport
1972	Insecticide, Fungicide, and Rodenticide Act	Classifies pesticides and regulates their use
1974	Safe Drinking Water Act	Sets safe limits on chemicals in drinking water
1974	Hazardous Materials Transportation Act	Regulates transport of hazardous materials
1976	Resource Conservation and Recovery Act	Regulates the treatment, storage, and disposal of hazardous waste
1976	Toxic Substances Control Act	Regulates use of dangerous chemical substances
1980	Comprehensive Response Liability Act ("Superfund")	Provides funds for cleanup of toxic waste dump sites that endanger the public
1987	Water Quality Act	Continues support for sewage treatment plants, initiates new programs to control nonpoint pollution sources, and imposes tighter controls on toxic pollutants

(NOTE: Various state environmental agencies have passed additional legislation to control specific environmental problems in their area.)

INFORMATION SHEET

XIII. Watersheds

A. Watershed is the total drainage area where water flows to a common point such as a river or lake.

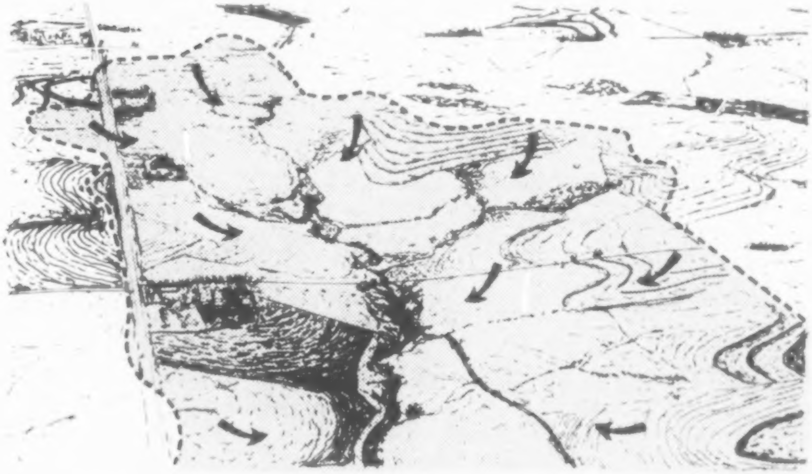
(NOTE: Watersheds are also often called basins or drainage areas.)

B. Watersheds vary in size.

1. Small watersheds may drain only a few acres before the water is contained in a farm pond or lake.

2. Large watersheds may cover millions of acres and drain water from several states.

Example: Watershed



C. Water collected in watersheds is carried away by streams or rivers or is collected behind dams for various uses.

D. Rainwater or water collected in watersheds may also seep into aquifers.

E. Land areas where surface water enters aquifers are called ground water recharge areas.

F. Water pollution is generally caused by human activities on land within the watershed.

Examples: Industrial waste; agricultural chemicals (pesticides, fertilizers); sediment from construction, farmlands, and mining activities; acid rain from fossil fuel combustion; solid waste disposal sites; municipal sewage treatment plants

INFORMATION SHEET

XIV. Water measurements

(NOTE: It is necessary to use abbreviations and conversion factors when determining water volume, water flow, and water quality.)

A. Water volume is measured in:

  1. Milliliter (ml) = 1/1000 of a liter
  2. Liter (l) = 1000 ml
  3. Gallon (gal)
  4. Cubic feet (cu.ft.) = 7.48 gal
  5. Acre foot (for lake water volumes) — 1 acre of water, 1 foot deep = 326,000 gal

B. Water flow is measured in:

  1. Gallons per minute (GPM) — This is usually how water well flow is measured.
  2. Cubic feet per second (cu.ft./sec) — This is usually how stream and river flow is measured.

C. Water quality is measured in:

  1. Parts per million (PPM) — 1 part contaminant per 1 million parts water
  2. Parts per billion (PPB) — 1 part contaminant per 1 billion parts water
  3. Milligram per liter (mg/l) = 1/1000 of a gram in 1 liter of water

     (NOTE: Milligram per liter and parts per million are equal. Parts per million is more commonly used.)

XV. Careers in water resource management

A. Hydrologist

B. Chemist

C. Geohydrologist

D. Soil scientist

E. Environmental scientist

F. Biologist

G. Chemical engineer

INFORMATION SHEET

H. Sanitary engineer

I. Agricultural engineer

J. Chemical, physical, and biological technician

(NOTE: Salaries of individual careers are dependent upon your level of education and experience.)

WATER RESOURCE MANAGEMENT
UNIT II

ASSIGNMENT SHEET #1 — SURVEY YOUR AREA TO IDENTIFY WATER POLLUTION SOURCES

NAME ______________________ SCORE __________

EVALUATION CRITERIA	
Criteria	Rating
Points were identified for area	______
Student's evaluation of environment problems	______
Report was neat and completed on time	______

Directions: Identify points of potential pollution in your area. List below and state your estimation of whether or not the points of potential pollution are causing environmental problems. Explain problems.

Pollution	Environmental Problem
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

WATER RESOURCE MANAGEMENT
UNIT II

ASSIGNMENT SHEET #2 — EVALUATE YOUR SOURCE OF DRINKING WATER

NAME ______________________________ SCORE ________

EVALUATION CRITERIA

Criteria	Rating
Information is correct	____
Potential sources of contamination are realistic	____
Explanation of safety of drinking water is acceptable	____
Assignment was neat and completed on time	____

Directions:

1. Where does your drinking water come from, both at home and at school?

   ____

2. Is your drinking water treated? ______________________________
3. If your drinking water is treated, how is it treated? ______________________
4. How often is your drinking water tested? ______________________
5. What did the last test of your drinking water show? ______________________

   ____

6. What are the potential sources of contamination to your drinking water?

   ____

7. In your opinion, is the water you drink safe? Explain. ________________

   ____

   ____

WATER RESOURCE MANAGEMENT
UNIT II

ASSIGNMENT SHEET #3 — CALCULATE WATER MEASUREMENTS

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Acre feet calculations are correct.	______
Gallons per acre calculations are correct.	______
Assignment was neat and completed on time.	______

Directions:

1. Determine the annual rainfall in your area. ______________________

2. Divide that number by 12 to determine acre-feet. ______________________

   (NOTE: This will give you the number of feet of rain or *acre feet* that falls in your area annually.)

3. Multiply the acre feet by 326,000 gal. to determine the gallons per acre. ______________________

   (NOTE: This is the number of gallons in one acre foot.)

Example:

1) If annual rainfall in the area is 18",
2) 18" ÷ 12 = 1.5 acre-feet
3) 1.5 × 326,000 gal. = 489,000 gal per acre

WATER RESOURCE MANAGEMENT
UNIT II

TEST

NAME ______________________________ SCORE __________

1. Match the terms on the right with the correct definitions.

______a. Continuous circulation of water between the oceans, atmosphere, and the earth's surface

______b. Water which has evaporated and is suspended in the air

______c. Water which seeps through the earth's surface and into ground water aquifers

______d. Water visible on the earth's surface

______e. Water found beneath the earth's surface

______f. Sand, gravel, or rock formation found below the earth's surface which is saturated with water

______g. Water which is made chemically, biologically, or physically impure for use

______h. Pollution which can be traced to a point of discharge

______i. Pollution which enters the environment from a wide area

______j. Waste generated by industry

______k. Waste from cities, primarily sewage

______l. A chemical used to kill or control pests

______m. A waste treatment system used primarily in rural areas

______n. Waste that poses a serious threat to human health, even at low concentrations

______o. The total drainage area where water flows to a common point

1. Aquifer
2. Ground water
3. Ground water recharge
4. Hazardous/toxic waste
5. Hazardous waste site
6. Heavy metals
7. Hydrologic cycle
8. Industrial waste
9. Municipal waste
10. Nonpoint source pollution
11. Pesticide
12. Point source pollution
13. Septic system
14. Surface water
15. Water pollution
16. Watershed
17. Water vapor

TEST

2. Select true statements concerning the history of water in the U.S. by placing a T or F next to the true or false statements.

______a. Most organisms can survive without water.

______b. As the United States was settled, the availability of water was of prime concern.

______c. Major population centers are located near major waterways.

______d. Industry does not require water.

______e. In general, water was not an important natural resource.

3. Complete statements concerning water distribution by circling the correct words.

a. Water covers about (50, 70) percent of the earth's surface.

b. About (47, 97) percent of the surface water is salt water.

c. (25, 97) percent of fresh water is contained in underground reservoirs.

d. Only (3, 10) percent of fresh water in the U.S. exists in streams and lakes.

e. The volume of ground water that is economically recoverable in the U.S. is equal to (3, 9) times the volume of the Great Lakes.

4. List four uses of water.

a. ____

b. ____

c. ____

d. ____

5. Complete statements concerning the hydrologic (water) cycle by selecting your answer from the multiple choices.

______a. Water exists in various forms. They are

1) Liquid and solid
2) Solid, vapor, and gas
3) Vapor and liquid
4) Liquid, solid, and vapor

TEST

______b. The total volume of water on earth

1) Changes when it rains
2) Varies according to average annual rainfall
3) Remains constant
4) Is less during a long drought

______c. The hydrologic cycle is

1) Water which accumulates after a rain
2) A whirlpool caused by rotating water
3) A vehicle which runs on water
4) Water continuously moving between oceans, atmosphere, and the earth's surface.

______d. Water supplies lost to evaporation, runoff, and human use

1) Cannot be replaced
2) Are restored by the hydrologic cycle
3) Are insignificant because there is an abundance of water
4) Are replaced by drilling of water wells

6. Complete statements concerning surface water by filling in the blanks with the correct words.

a. Two examples of surface water are ______________ and ______________.

b. Surface water must be treated before it can be used for ________________.

c. Since quantities of surface waters are limited, their use must be __________.

7. Select true statements concerning ground water by placing a T or F next to the true or false statements.

______a. Ground water is water which is found below the earth's surface.

______b. Ground water exists as lakes and rivers underground.

______c. Half of all Americans and 95% of rural Americans use ground water for drinking water.

______d. Ground water aquifers are sand, gravel, and rock formations.

______e. All ground water is located over 100 feet deep.

______f. Aquifers vary in thickness from a few feet to several hundred feet.

______g. Ground water moves rapidly from a mile to several miles per day.

______h. Ground water, protected by overlying soils, cannot be contaminated.

TEST

______i. Ground water resources are unlimited.

______j. Artesian wells are created when aquifer elevations are higher than the top of the well drilled into the aquifer.

8. Describe the relationship between ground water and surface water.

____

____

____

9. Select true statements concerning water pollution by placing a T or F next to the true or false statements.

_____a. Water pollution has caused serious epidemics such as rabies.

_____b. Rural water wells are often contaminated by livestock and human waste.

_____c. Pollution which can be traced to a point of discharge is called nonpoint source pollution.

_____d. Today water is more likely to be chemically impure rather than biologically impure.

10. Compare the state of the environment of 1960 and 1990 by placing "1960" or "1990" next to the conditions that existed in those years.

_____a. Surface waters are severely polluted.

_____b. Fish and shellfish are unfit for human consumption.

_____c. Industry waste discharges are regulated and enforced.

_____d. Funds are available to cleanup existing hazardous waste sites.

_____e. Wetlands are considered unimportant and are not protected.

_____f. Untreated sewage is dumped into streams and rivers.

11. Select true statements concerning hazardous/toxic waste by placing a T or F next to the true or false statements.

______a. Improper hazardous waste disposal is a serious threat to water resources.

______b. Hazardous waste is generated by petrochemical plants, fertilizer manufacturers, plastic manufacturers, and metal refineries.

______c. If hazardous waste is placed in dumps and covered with soil, it is safe.

TEST

______d. There are only 10 hazardous waste sites in the U.S.

______e. Municipal landfills pose no threat to the environment.

______f. Underground storage tanks are not an environmental problem.

______g. Chemicals in plastics, solvents, pesticides, paints, and dyes are sources of hazardous waste.

______h. Health problems associated with hazardous waste contamination include cancer, brain and nerve damage, and birth defects.

12. Match federal legislation for environmental protection of water resources with their intended purposes.

______a. Sets safe limits on chemicals in drinking water

______b. Regulates transport of hazardous materials

______c. Provides funds for cleanup of toxic waste dump sites

______d. Requires environmental impact statements for all projects affecting the environment

______e. Regulates discharges from industry and sewage treatment plants

______f. Continues support for sewage treatment plants, initiates new programs to control nonpoint pollution sources, and imposes tighter controls on toxic pollutants

______g. Regulates the treatment, storage, and disposal of hazardous waste

______h. Regulates use of dangerous chemical substances

______i. Classifies pesticides and regulates their use

______j. Regulates oil transport

1. 1970 National Environmental Policy Act
2. 1972 Clean Water Act
3. 1972 Marine Protection Research and Sanctuaries Act
4. 1972 Ports and Waterways Safety Act
5. 1972 Insecticide, Fungicide, and Rodenticide Act
6. 1974 Safe Drinking Water Act
7. 1974 Hazardous Materials Transportation Act
8. 1976 Resource Conservation and Recovery Act
9. 1976 Toxic Substances Control Act
10. 1980 Comprehensive Response Liability Act ("Superfund")
11. 1987 Water Quality Act

TEST

13. Select true statements concerning watersheds by placing a T or F next to the true or false statements.

______a. A watershed is where the water starts (source).

______b. Watersheds vary in size.

______c. Water collected in watersheds in carried away by streams or seeps into aquifers.

______d. Land areas where surface water enters ground water aquifers are called springs.

______e. Water pollution is generally caused by human activities on land within the watershed.

14. Match water measurement terms with their definitions or equivalents.

______a. 7.48 gallons

______b. Gallons per minute

______c. 1000 milliliters

______d. 1/1000 of a liter

______e. Cubic feet per second

______f. 1 part contaminant per 1 million parts water

______g. 1 foot of water covering one acre

______h. 1 part contaminant per 1 billion parts water

1. Acre foot
2. Cubic feet
3. Cu.ft./sec.
4. Gallon
5. GPM
6. Kiloliter
7. Liter
8. Milliliter
9. Parts per billion
10. Parts per million

15. List five career opportunities in water resource management.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

16. Survey your area to identify water pollution sources. (Assignment Sheet #1)

17. Evaluate your source of drinking water. (Assignment Sheet #2)

18. Calculate water measurements. (Assignment Sheet #3)

WATER RESOURCE MANAGEMENT
UNIT II

ANSWERS TO TEST

1.

a.	7	f.	1	k.	9
b.	17	g.	15	l.	11
c.	3	h.	12	m.	13
d.	14	i.	10	n.	4
e.	2	j.	8	o.	16

2. a. F
   b. T
   c. T
   d. F
   e. F

3. a. 70
   b. 97
   c. 97
   d. 3
   e. 9

4. Any four of the following:

   a. Domestic
   b. Agricultural
   c. Industrial
   d. Business
   e. Fish and wildlife habitats
   f. Recreation

5. a. 4
   b. 3
   c. 4
   d. 2

6. a. Any two of the following: Streams, farm ponds, lakes, rivers, oceans, wetlands, swamps, and estuaries
   b. Domestic consumption (use) or industrial processes.
   c. Regulated or conserved

7.

a.	T	f.	T
b.	F	g.	F
c.	T	h.	F
d.	T	i.	F
e.	F	j.	T

ANSWERS TO TEST

8. Description should include the fact that the quality and quantity of one affects the other.

9.
a. F
b. T
c. F
d. T

10.

a.	1960	d.	1990
b.	1960	e.	1960
c.	1990	f.	1960

11.

a.	T	e.	F
b.	T	f.	F
c.	F	g.	T
d.	F	h.	T

12.

a.	6	f.	11
b.	7	g.	8
c.	10	h.	9
d.	1	i.	5
e.	2	j.	4

13.

a.	F	d.	F
b.	T	e.	T
c.	T		

14.

a.	2	e.	3
b.	5	f.	10
c.	7	g.	1
d.	8	h.	9

15. Any five of the following:

a. Hydrologist
b. Chemist
c. Geohydrologist
d. Soil scientist
e. Environmental scientist
f. Biologist
g. Chemical engineer
h. Sanitary engineer
i. Agricultural engineer
j. Chemical physical, and biological technician

16-18. Evaluated to the satisfaction of the instructor

LAND MANAGEMENT
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to perform and interpret a soil test, read a soil survey map, and review a conservation plan and land use plan. Competencies will be demonstrated by completing the assignment sheets, job sheets, and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to land management with the correct definitions.
2. Complete statements concerning how soils are formed.
3. Match types of rocks with the correct definitions.
4. Select from a list the weathering factors.
5. Match types of soils with the ways they are deposited.
6. Distinguish among the major soil texture classes.
7. Select from a list the composition of an average soil.
8. Select from a list the functions of organic matter.
9. Identify the three horizons of a soil profile.
10. Match the land capability classes with the correct definitions.
11. Select true statements concerning soil testing.
12. Distinguish between major and minor plant nutrients.
13. Identify nutrients in a fertilizer analysis.
14. Select true statements concerning soil survey reports.
15. List the types of erosion.
16. List causes of erosion.
17. Complete statements concerning the effects of erosion.
18. Select from a list the contributors to erosion pollution.

SPECIFIC OBJECTIVES

19. List methods of controlling erosion on the farm.

20. List methods of controlling urban erosion.

21. List stewards of the soil.

22. Match the Conservation Provisions of the 1985 Farm Bill with the correct descriptions.

23. List parts of a conservation plan.

24. Select true statements concerning reclamation of mined lands.

25. List land management careers.

26. Read a soil test report. (Assignment Sheet #1)

27. Complete a land use planning summary. (Assignment Sheet #2)

28. Read a soil survey map. (Assignment Sheet #3)

29. Read a conservation plan. (Assignment Sheet #4)

30. Demonstrate the ability to:

    a. Take a lawn and garden soil sample. (Job Sheet #1)

    b. Perform a soil test to determine organic matter. (Job Sheet #2)

    c. Determine percent of soil particles. (Job Sheet #3)

LAND MANAGEMENT
UNIT III

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Soil Textures and Their Particles — Objective 6

TM 2 — Soil Profile — Objective 9

TM 3 — Controlling Erosion on Farmlands — Objective 19

TM 4 — Controlling Erosion Along Riverbanks — Objective 20

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheets.

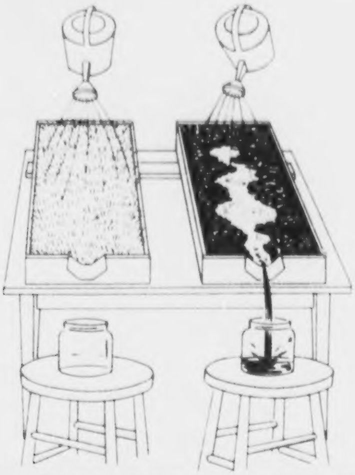
H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit.

1. Show the different sizes of soil particles by sifting soil through various sizes of sieves.
2. Use a soil test syringe to force water through soil samples to show how water moves differently through different soils.
3. Do a percolation test.
4. Collect soil samples. (Job Sheets #1 and #2)
5. Send soil samples to a soil test lab. Provide appropriate forms for your state's lab. (Assignment Sheet #1)

SUGGESTED ACTIVITIES

6. Demonstrate erosion with soil boxes, one with bare soil and the other with grass or mulch to show the difference in soil loss.



Courtesy of USDA Soil Conservation Service

7. Use local soil survey maps to identify soils in your area. (Assignment Sheet #3)

8. Discuss examples of poor soil management in your area.

9. Visit a fertilizer plant.

10. Place fertilizer particles in a jar and watch solubility.

11. Prepare a compost pile.

12. Identify areas of water erosion in your area.

13. Identify areas of good erosion control management.

14. Have students collect water samples from various streams after a heavy rain to determine the amount of sediment being washed away. Samples should come from streams being fed by cultivated fields, construction sites, pastures, woods, residential areas, etc. Let samples settle for several days and then discuss the results.

15. Demonstrate water entry into different soils by pouring water into a coffee can (without top or bottom) that has been pounded into the ground and time rate of percolation.

16. Demonstrate how to pace, and have students practice pacing various distances — 100 ft, 1 acre, etc.

17. Show actual topographic maps, and demonstrate how to read them.

SUGGESTED ACTIVITIES

18. The Redco Science Kit (What's In a Soil) called for in Job Sheet #2 is a relatively inexpensive kit available to schools in quantity. (Currently twelve stations cost about $60.) Other kits similar to the Redco kit may also be used. The Redco kit is available from:

    Nasco
    901 Janesville Avenue
    Box 901
    Fort Atkinson, Wisconsin

19. Students may wish to have a soil conservation project to qualify for an FFA Soil and Water Management Proficiency Award. Refer to the *FFA Proficiency Award Handbook* for more details.

20. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Knuti, Leo L. *Profitable Soil Management*, 4th ed. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1984.

B. Camp, William G. *Managing Our Natural Resources*. Albany, NY: Delmar Publishers, Inc., 1988.

C. U.S. Department of Agriculture. Soil Conservation Service. P.O. Box 2890, Washington, D.C. 20013-2890.

    1. *Conserving Soil.*
    2. *Soil Erosion by Water,* Agriculture Information Bulletin 513.
    3. *Soil Erosion by Wind*, Agriculture Information Bulletin 555.
    4. *Farming and Maintaining Terraces*, Leaflet 570.
    5. *Save Soil Systematically*, Program Aid 1366.
    6. *Going Wild with Soil and Water Conservation*, Program Aid 1363.
    7. *Tillage Options for Conservation Farmers*, Program Aid 1416.
    8. *Sediment*, Agriculture Information Bulletin 325.

SUGGESTED ACTIVITIES

D. Cooperative Extension Service. *Soil Erosion By Water and Its Control.* North Dakota State University, Fargo, ND. January , 1977.

E. USDA. *Wind Erosion.* Soil Conservation Service. Huron, SD.

F. Harp, Keith and Jim Steward. *Vocational Agriculture II.* Stillwater, OK: CIMC/Oklahoma Department of Vocational and Technical Education, 1986.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Donahue, Roy L. *Our Soils and Their Management*, 5th ed. Danville, IL: The Interstate Printers & Publishers, Inc., 1983.

B. Kircher, Harry B. *Our Natural Resources*, 6th ed. Danville, IL: The Interstate Publishers & Printers. 1988.

C. "Soil Texture Unit, Model 1067, #77330." Forestry Supplies, Box 8391, Jackson, MS 39284. (approximately $25)

D. Computer software — *Soil Evaluation, Fertility, and Related Review.* For Apple and IBM. Has questions on soil profile, soil development, land capability, and land use. Available from:

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112

E. Films and videotapes

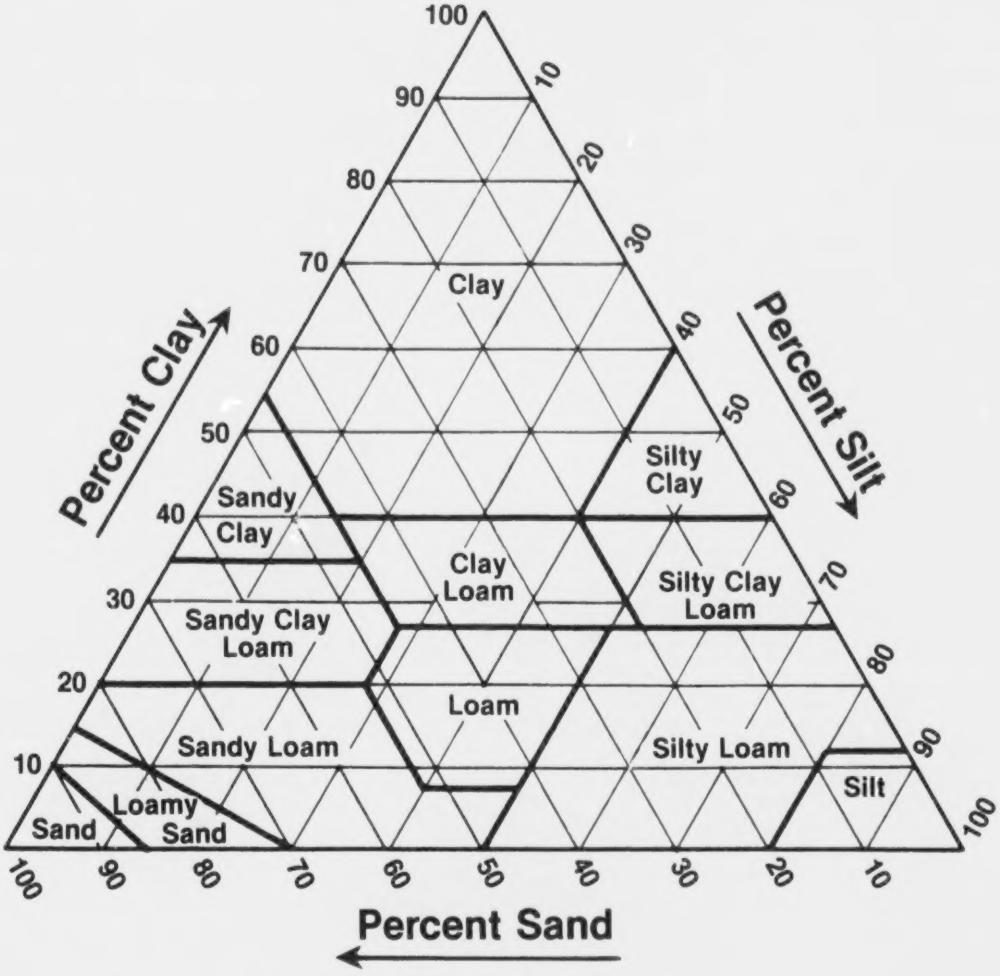
1. *Seeds of Survival.* © 1983, 25 min. video. Discusses three major problems affecting farmers — economic survival, soil erosion, and health threats and their interrelationship through the use of synthetic fertilizers and pesticides. Available from:

   Film Fair Communications
   10621 Magnolia Blvd.
   North Hollywood, CA 91601
   818-985-0244

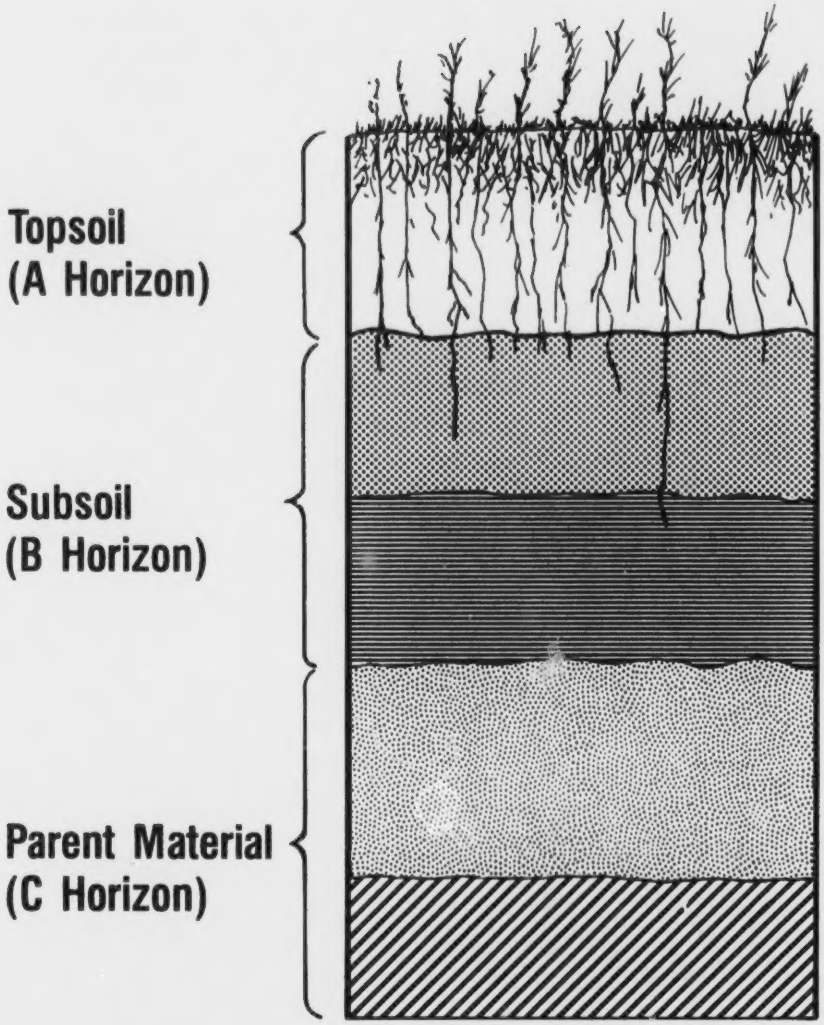
2. *On American Soil.* ©1985. 28 min. 16mm or video. Produced by the Conservation Foundation. Discusses soil erosion in America today. Available from:

   Bull Frog Films, Inc.
   Oley, PA 19547
   800-543-FROG

Soil Textures and Their Particles

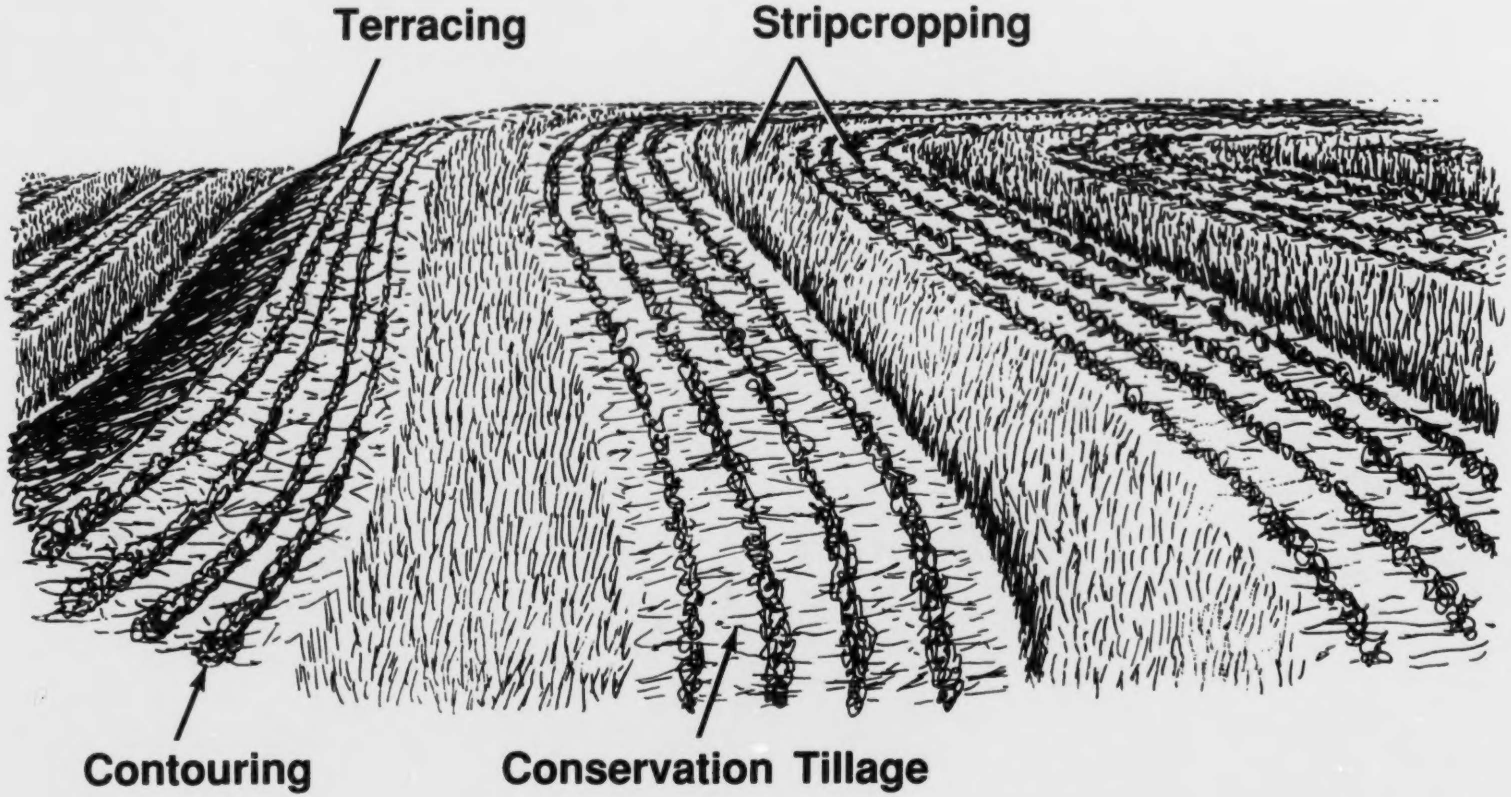

100
90
80
70
60
50
40
30
20
10
Percent Clay
10
20
30
40
50
60
70
80
90
100
Percent Silt
100
90
80
70
60
50
40
30
20
10
Percent Sand
Clay
Sandy Clay
Silty Clay
Clay Loam
Silty Clay Loam
Sandy Clay Loam
Loam
Sandy Loam
Silty Loam
Silt
Loamy Sand
Sand

Soil Profile


Topsoil
(A Horizon)
Subsoil
(B Horizon)
Parent Material
(C Horizon)

Courtesy of Oklahoma CIMC

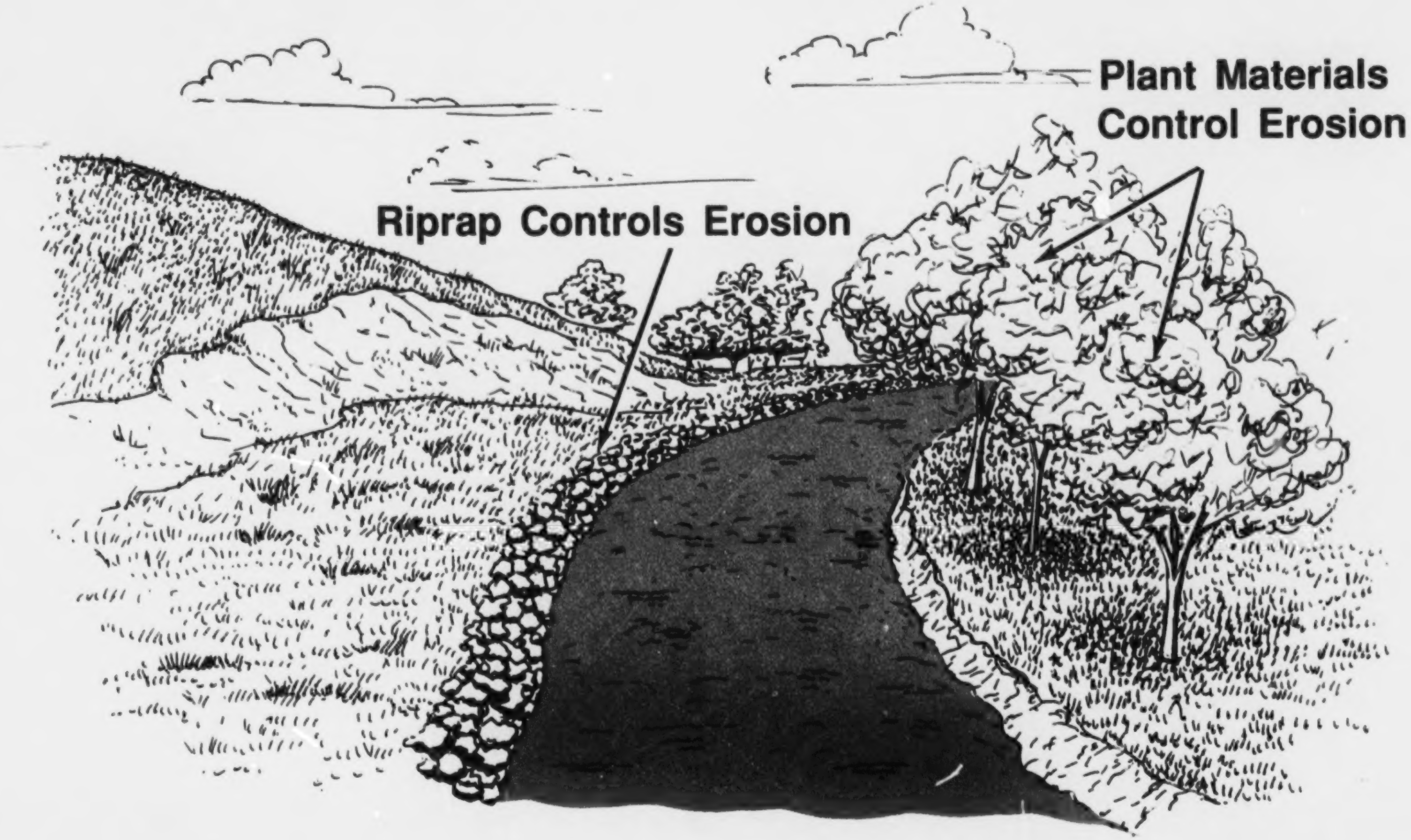
Controlling Erosion on Farmlands


Terracing
Stripcropping
Contouring
Conservation Tillage

TM 3

NR-111

Controlling Erosion Along Riverbanks


Plant Materials
Control Erosion
Riprap Controls Erosion

LAND MANAGEMENT
UNIT III

INFORMATION SHEET

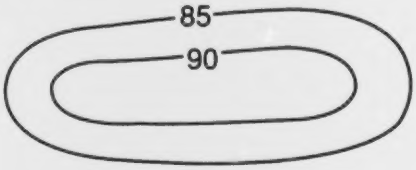
I. **Terms and definitions**

A. Bacteria — Microscopic, single-celled plants

B. Compaction — Pressing soil particles closer together which leaves less pore spaces available for air or water in the soil

C. Contour — An imaginary line along the ground connecting all points of the same elevation

Example:



(NOTE: Contours are followed when farming to control erosion.)

D. Erosion — The wearing away of land surface

E. Fertilizer — An organic or inorganic material that is added to the soil to supply elements essential to plant growth

F. Flood hazard — Refers to the likelihood that an area will receive flood damage

G. Humus — Highly decomposed plant and animal residue that is a part of soil

H. Inert material — A clay material used as a filler in fertilizer applications

I. Land capability class — The suitability of land for use without permanent damage

J. Land management — The planning and implementation of practices applied to the land

K. Land use planning — A process to determine the uses of a given land

L. Loam — A soil material that contains relatively equal amounts of sand, silt, and clay particles

M. Mineral — A naturally-occurring inorganic substance in the soil

N. Mulch — A layer of plant residue on the soil surface

O. Organic material — Plant and animal matter in various stages of decay

INFORMATION SHEET

P. Parent material — The earth materials from which soil is formed

Q. Percolation — The downward movement of water into the soil

R. Permeability — The ability of the soil to allow air and water to move through it

S. pH — A scale which represent alkalinity or acidity

T. Plant nutrients — Elements essential for plant growth

U. Reclamation — Transforming barren mine areas as nearly as possible to their original condition

T. Slope — The angle of the soil surface expressed as a percent of rise and fall

U. Soil — The outer portion of the earth's crust that supports plant life

V. Soil auger — A tool used to bore into the soil and withdraw a soil sample

W. Soil horizon — A layer of soil materials

X. Soil profile — Vertical section of a soil horizon

Y. Soil type — A soil series based on surface texture

Z. Soil map — A map showing the distribution of soil types

AA. Soil survey — The systematic examination, description, classification, and mapping of soils in an area

BB. Texture — The fineness or coarseness (size) of soil particles

CC. Topography — The physical features (natural and man-made) on the land's surface

DD. Weathering — The actions that break down rock into soil

EE. Windbreak — A living barrier of trees and shrubs designed for protection from wind and/or snow

II. How soils are formed

A. Soil starts out as rock.

B. Weathering factors work to break rocks down.

C. Soil types are based upon the type of rock from which it is made.

INFORMATION SHEET

D. Rock particles are further broken into various smaller sizes of rocks and minerals.

E. Small plants (lichens and mosses) begin to grow within the rock particles.

F. Dead plant materials (organic matter) are mixed with rock fragments.

G. As more organic matter is formed, larger plant forms (ferns, grasses, shrubs) take root.

H. Bacteria and fungi break down the organic matter into simpler nutrients that are released into the soil.

(NOTE: This is a very slow process requiring thousands of years.)

III. Types of rocks

A. Igneous — Formed by hardening of molten volcanic materials.

B. Sedimentary — Formed by a consolidation of particles laid down over the years.

C. Metamorphic — Formed as a result of changes in other rocks under heat and pressure.

IV. Weathering factors

A. Temperature changes — Heating and cooling cause rock to crack.

B. Winds — Sand may be blown against a larger rock.

C. Water — Dissolves water-soluble minerals.

D. Chemicals — Chemicals dissolved in the soil water eat rock away.

E. Ice — Expansion of frozen water can cause rocks to break.

F. Glaciers — Flowing ice can move rocks and grind them into pieces.

V. Ways soils are deposited

A. Glacial soils — Deposited by glaciers

B. Loess soils — Deposited by wind

C. Alluvial soils — Deposited by moving fresh water

INFORMATION SHEET

VI. Major soil texture classes

(NOTE: Soil particles are classified into texture classes based on particle size and the percentages of sand, silt, and clay particles present.)

A. Sand

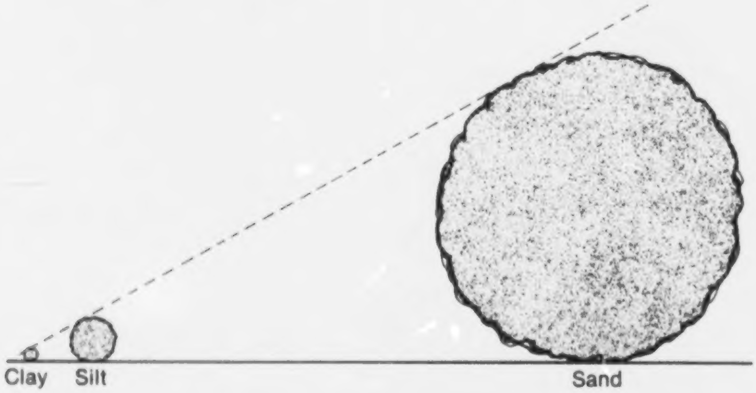
1. A coarse-textured soil
2. Grains can easily be seen and felt.
3. When dry, will fall apart; when wet, will form a cast.
4. Has high permeability rate

B. Silt

1. A medium-textured soil
2. Feels smooth and talc-like when wet
3. Most grains are difficult to see.
4. Has medium permeability rate

C. Clay

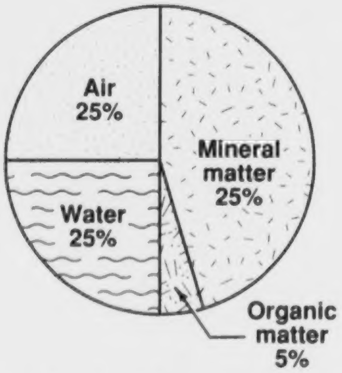
1. A fine-textured soil
2. When wet, will form an inch-long ribbon.
3. Individual grains are impossible to see with an unaided eye.
4. Has low permeability rate



Courtesy of Oklahoma CIMC

INFORMATION SHEET

VII. **Composition of an average soil**



A. Mineral matter — 45%

Examples: Clay, silt, sand, gravel

B. Water — 25%

C. Air — 25%

D. Organic matter — 5%

Examples: Living and dead organisms

(NOTE: These figures are for an average soil. Specific soils will vary.)

VIII. **Functions of organic matter**

A. Serves as a cementing agent for soil particles

B. Returns plant nutrients to the soil

C. Stores soil moisture

D. Provides food for soil microorganisms

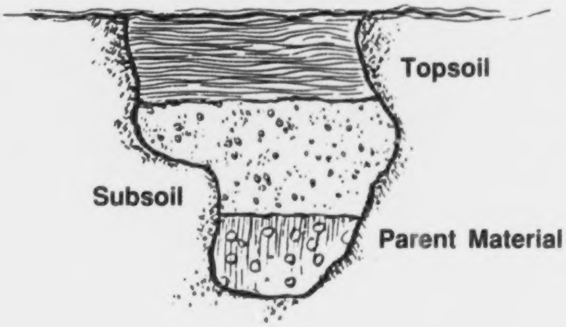
E. Makes soil more tillable

IX. **Horizons of a soil profile**

A. Topsoil

B. Subsoil

C. Parent material



Courtesy of Oklahoma CIMC

INFORMATION SHEET

XIII. Land capability classes

(NOTE: These classes categorize soil according to its productivity.)

A. Class I-IV — Soils that can be used for cultivated crops but require proper land management

B. Class V-VII — Soils unsuited for cultivated crops and restricted largely to grazing, woodland, or wildlife

C. Class VIII — Soils suited only for recreation, wildlife, water supply, or aesthetic purposes

XI. Soil testing

A. Soils differ in the amount of nutrients they can supply to plants.

B. A soil test will estimate the amount of nutrients a soil can provide to a plant.

C. Adding major plant nutrients based on a soil test can increase yield and will improve quality of the plant.

D. Soil tests can also determine the pH of the soil and the soil texture.

XII. Plant nutrients

A. Major plant nutrients

1. Nitrogen
2. Phosphorus
3. Potassium

B. Minor plant nutrients

(NOTE: These nutrients are needed by the plant in very small quantities but are of major importance nevertheless. Most minor nutrients are available in sufficient quantities in the soil, although a soil analysis may detect deficiencies which need to be supplemented.)

1. Zinc
2. Manganese
3. Boron
4. Copper
5. Iron

INFORMATION SHEET

6. Molybdenum
7. Calcium
8. Sulfur
9. Chlorine
10. Magnesium

XIII. Nutrients in a fertilizer analysis

(NOTE: Fertilizers are a mix of inert material and a percent of major nutrients. Some fertilizers have minor nutrients added to the mix based on the need.)

A. Nitrogen (N) — First nutrient represented in a fertilizer analysis

B. Phosphorus (P) — Second nutrient represented in a fertilizer analysis

C. Potassium (K) — Third and last nutrient represented in a fertilizer analysis

Examples: Fertilizer Analyses

33-0-0	26-10-3	5-10-10
N P K	N P K	N P K

XIV. Soil survey reports

A. Contain aerial photograph maps of an entire county and indicate all soil types with soil map symbols or numbers that correspond to a legend of soil types. (Assignment Sheet #3)

B. Give descriptions of soils in that county.

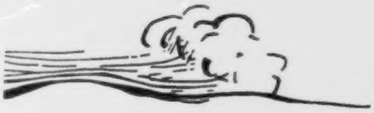
C. List management information to assist in land use planning.

   1. Agricultural data such as potential crop yield of a given soil type
   2. Engineering data such as suitability of a soil for roads or other civil structures
   3. Planning data such as suitability of a soil for homesites

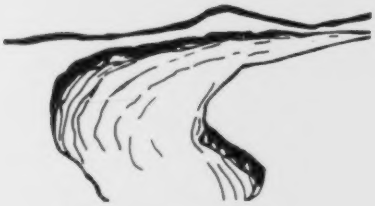
INFORMATION SHEET

XV. Types of erosion

A. Wind



B. Water



XVI. Causes of erosion

A. Moving water

B. Topography including slopes of the land

C. Lack of vegetation

D. Dry climate conditions

E. Wind

F. Human activities

XVII. Effects of erosion

A. Reduces fertility of land.

B. Increases sediment in water bodies.

C. Increases water filtration expenses.

D. Destroys spawning beds of game fish.

E. Reduces fish food supply.

F. Fills pools where fish live.

G. Increases the damage caused by floods.

INFORMATION SHEET

XVIII. Contributors to erosion pollution

A. Riverbank erosion

B. Farming erodible lands

C. Unprotected construction sites

D. Industrial and mining activities

XIX. Controlling erosion on the farm

A. Plant buffer strips of perennial grasses to hold soil particles.

B. Plant windbreaks to slow wind speeds.

C. Ridge soil into small furrows to trap soil particles.

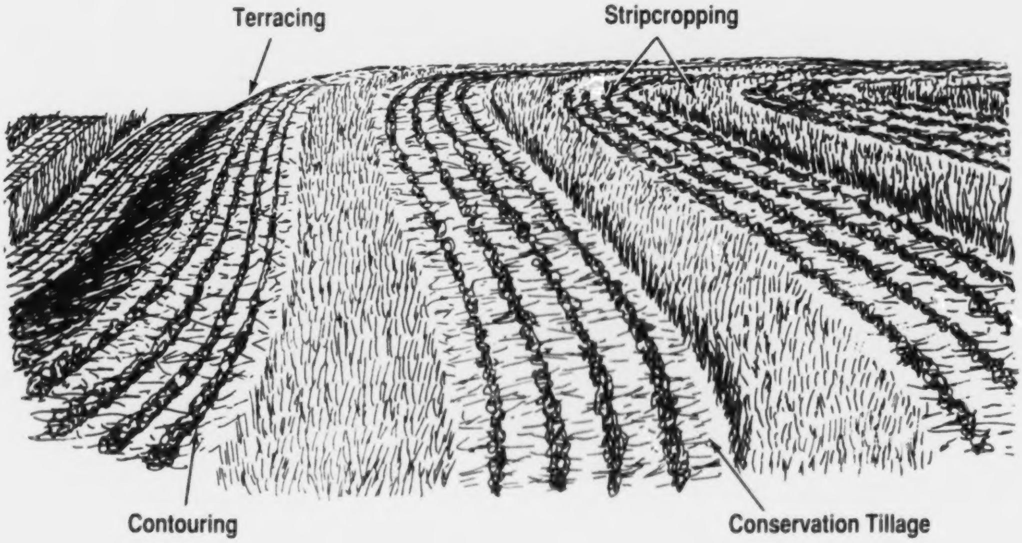
D. Provide diversions to channel excess runoff.

E. Farm on the contour rather than straight-row.

F. Terrace to control and manage water runoff.

G. Use contour stripcropping.

H. Use rotation cropping.



INFORMATION SHEET

I. Practice conservation tillage, which leaves all or a portion of the previous crop's residue on the soil surface after planting.

(NOTE: This can reduce erosion 50-90% compared to conventional tillage because the soil is not left bare. Crop residue is also beneficial to wildlife.)

J. Use tile drainage to remove excess underground water.

K. Use grassed waterways to channel excess runoff.

L. Mulch to hold soil in place.

M. Prevent overgrazing of pastures and rangelands.

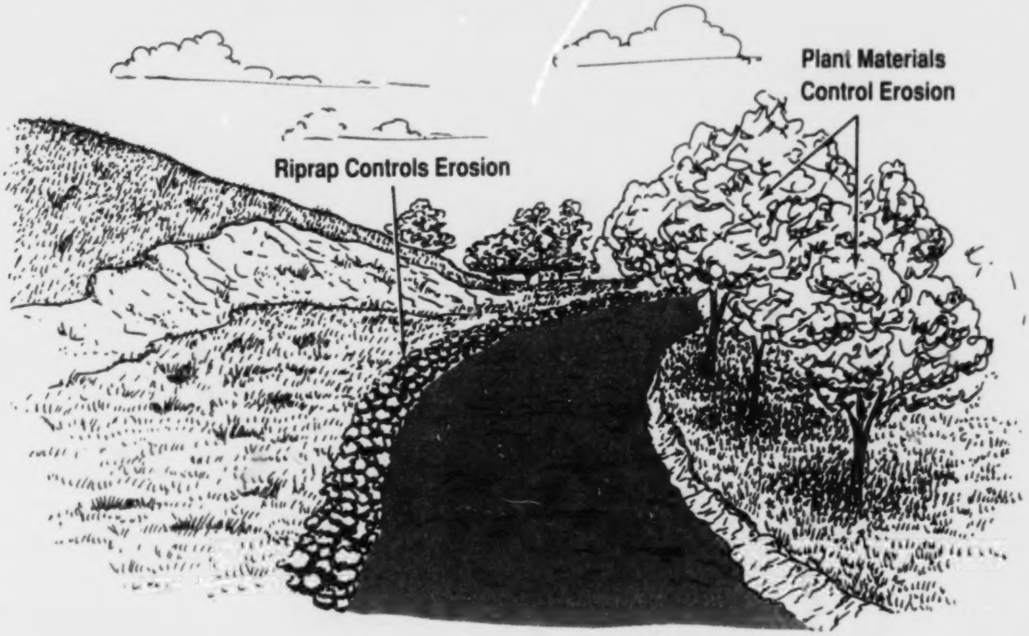
N. Use field borders of perennial vegetation to protect field edges.

XX. Methods of controlling urban erosion

A. Plant trees.

B. Plant grass and ground covers.

C. Place rock materials (rip-rapping) along riverbank to secure it.



INFORMATION SHEET

D. Leave vegetation on the soil as long as possible.

E. Disturb only the minimum of the construction area.

F. Cover bare spots with annual grasses, ground covers, sod, and mulch.

(NOTE: Bare soil is very susceptible to erosion.)

G. Use erosion blankets or netting during construction or while waiting for grass seed to sprout.

H. Protect slope from failure using jute matting, wooden strips placed across the slope, chemical-binding materials, grass, ground cover, or retaining walls.

I. Use stormwater diversions, berms, waterways, and sediment basins to channel or slow down runoff.

J. Base all building plans on scientific soil surveys.

XXI. Stewards of the soil

A. Private landowners

B. Research and education groups

1. Land-grant colleges
2. Cooperative Extension Services (state and county)
3. Agricultural experiment stations
4. High school agricultural education programs
5. Youth organizations — 4-H, FFA

C. Government agencies

1. Soil Conservation Service
2. Forest Service
3. Bureau of Land Management
4. Bureau of Indian Affairs
5. Agricultural Stabilization and Conservation Service
6. Corps of Engineers
7. State and district soil and water conservation offices

INFORMATION SHEET

XXII. Conservation Provisions of the 1985 Farm Bill

(NOTE: These provisions reflect the goals of the U.S. Department of Agriculture to protect highly erodible lands and wetlands from use as farmland.)

A. Conservation Reserve — Offers producers help in retiring highly erodible cropland.

B. Conservation Compliance (Effective January 1, 1990) — Requires farmers to develop and begin actively applying an approved conservation plan for highly erodible cropland.

(NOTE: Conservation plans must be fully implemented by January 1, 1995.)

C. Swampbuster — Discourages farmers from converting wetlands to croplands (may lose USDA program benefits)

D. Sodbuster — Discourages farmers from planting on new highly erodible land without a conservation plan (may lose USDA program benefits)

XXIII. Parts of a conservation plan (Assignment Sheet #4)

A. Soil map

B. Land use

C. Soil type and symbols

D. Acres

E. Capability class

F. Slope

G. Planned conservation treatment

XXIV. Reclamation of mined lands

A. Many mineral resources are obtained by surface mining.

Examples:

- Sand
- Gravel
- Stone
- Iron ore
- Coal
- Copper
- Uranium
- Phosphate
- Aluminum ore (bauxite)
- Gold

INFORMATION SHEET

B. Surface mining can be harmful to land.
   1. Earth is left barren which encourages erosion.
   2. Rivers and streams become choked with sediment.
   3. Water that drains through the mines becomes polluted with chemicals.

C. Because of erosion problems, surface strip-mines are required to have a reclamation plan.

D. Reclamation activities
   1. Earth-moving equipment fills the mined area with rock debris.
   2. The land is shaped until it resembles the original contour.
   3. Topsoil is spread over the area.
   4. Trees, shrubs, and a mixture of grass are planted.

XXV. Land management careers

A. Soil conservationist

B. Soil conservation technician

C. Soil scientist

D. Soil engineer

LAND MANAGEMENT
UNIT III

ASSIGNMENT SHEET #1 — READ A SOIL TEST REPORT

NAME_______________________________ SCORE ________________

Directions: Using the soil test report on the following page or one provided by your instructor, answer the questions below.

1. What is the field designation number? ____________

2. What is the laboratory number? ____________

3. Soil test results:

   a. Pounds of nitrogen — ____________

   b. Percent of organic matter — ____________

   c. Pounds of phosphorus — ____________

   d. Pounds of potassium — ____________

   e. pH — ____________

   f. Texture — ____________

4. Interpretation of test results:

   a. What is the level of nitrogen? ____________

   b. What is the level of phosphorus? ____________

   c. What is the level of potassium? ____________

   d. What is the level of organic matter? ____________

ASSIGNMENT SHEET #1

SOIL TEST REPORT

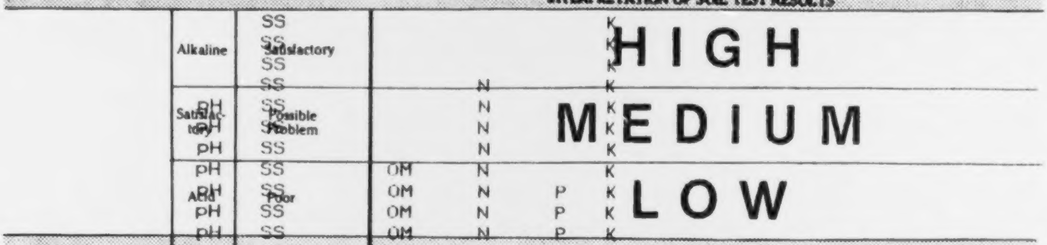
SOUTH DAKOTA STATE UNIVERSITY • SOIL TESTING LAB • 07 AG. HALL • BROOKINGS, SD 57007

TO-

HURON FFA-VOC. SCHOOL
18TH & ARIZONA S.W.
HURON SD 57350

County: BEADLE
Laboratory No.: 79164
Date Received: 03-27-90
Date Reported: 3-27-90
Record Number: 1058

INTERPRETATION OF SOIL TEST RESULTS



SOIL TEST RESULTS

Field Number	Soil Texture	Soil pH	Soluble Salts mmho/cm	Sodium me/l	Organic Matter %	Nitrogen NO_3-N Top lb/A	Nitrogen NO_3-N Total lb/A	Phosphorus P lb/A	Potassium K lb/A	Sulfur SO_4-S Top lb/A	Sulfur SO_4-S Total lb/A	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Calcium ppm	Magnesium ppm
1	FINE	7.6	0.4		2.4	13	44	8	730								

RECOMMENDATIONS

	N lb/A	P_2O_5 lb/A	K_2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	Ca lb/A	Mg lb/A
1st choice In 1990 for 50 BU/A OATS	21	26	0							
2nd choice										

- The P2O5 recommendation can be reduced by one-third if applying as a starter.

For additional information contact
your County Extension Agent:

HURON SD 57350

These statements are for
the first crop choice

LAND MANAGEMENT
UNIT III

ASSIGNMENT SHEET #2 — COMPLETE A LAND USE PLANNING SUMMARY

NAME____ SCORE ____________________

Directions: Using the information provided complete the Land Use Planning Summary on the next page or one provided by your instructor.

1. The 37 acres of field number one are in hayland.
2. The 16 acres of field number two are in hayland.
3. The planned practice for field number two is to seed in 1990.
4. The 2 acres of field number three are for the farmstead.
5. The 47 acres of field number four are for wildlife.
6. The planned practice for field number four is brush control in 1991.
7. The 138 acres of field number five are for rangeland.
8. The planned practice for field number five is to cross fence in 1992.
9. The 45 acres of field number six are for pastureland.
10. The planned practice for field number six is to seed in 1990.
11. Calculate the total acres and place in appropriate places at top and bottom of form.

ASSIGNMENT SHEET #2

USDA-SCS

LAND USE PLANNING SUMMARY

Cooperator ______________________________ Acres _____________ CD __________

Assisted by ____ Date ________

Field	Acres	Land Use					Planned Practices
		Hay Land	Wild Life	Farm Stead	Range Land	Pasture Land	
Total							

LAND MANAGEMENT
UNIT III

ASSIGNMENT SHEET #3 — READ A SOIL SURVEY MAP

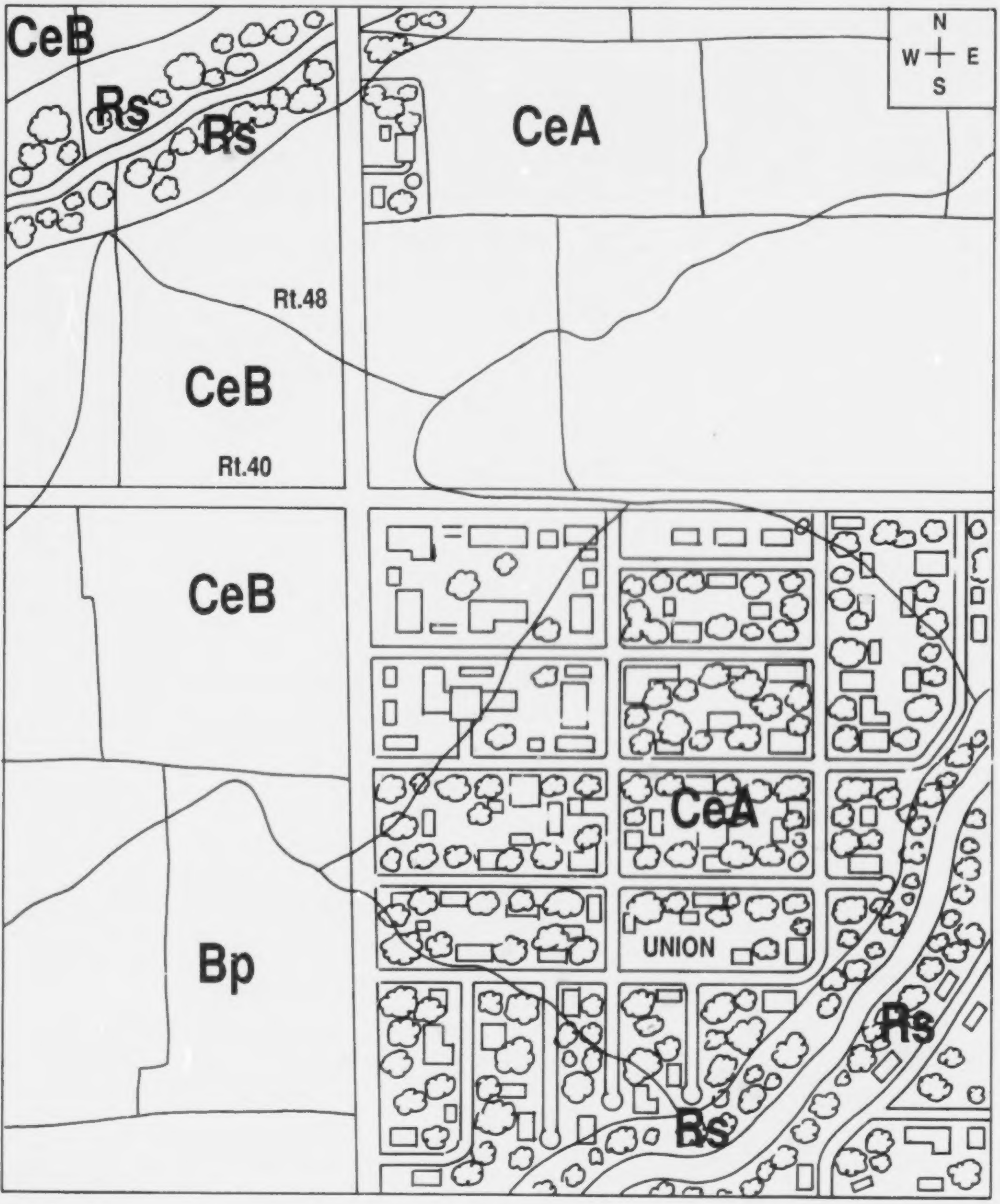
NAME____ SCORE ____________________

Directions: Using the soil survey map on the next page, answer the following questions.

1. List the different soil type map symbols.
    a. __________
    b. __________
    c. __________
    d. __________
2. In what corner of the map is the large residential area? ____________________
3. What soil type is found in the residential area? ____________________
4. What soil type is located in areas of streams and possible lowlands? __________
5. What soil type is located east of the farmstead? ____________________

ASSIGNMENT SHEET #3

Soil Survey Map


CeB
Rs
Rs
CeA
N
W
E
S
Rt.48
CeB
Rt.40
CeB
CeA
UNION
Bp
Rs
Rs

LAND MANAGEMENT
UNIT III

ASSIGNMENT SHEET #4 — READ A CONSERVATION PLAN

NAME______________________________ SCORE ________________

Directions: Using the conservation plan map provided on the next page, answer the following questions.

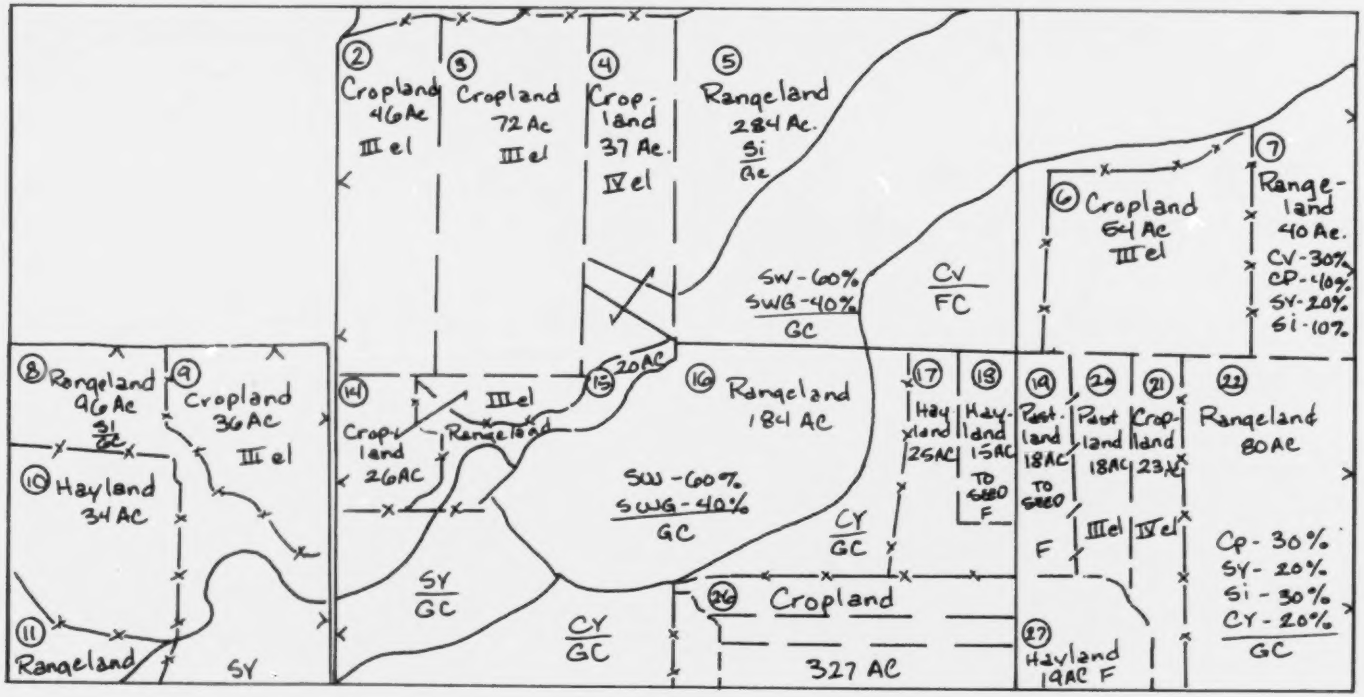
1. What is the county? ____________________________
2. Who was the USDA Soil Conservation Service person who assisted in the development of this plan? ____________________________
3. How many acres are in field number 2? ____________________________
4. What is field number 5 used for? ____________________________
5. What is the land capability class of field number 9? __________________
6. What is the conservation practice for field number 19? __________________
7. What is the field number 6 used for? ____________________________
8. Who owns this land? ____________________________
9. How many acres are in field number 17? ____________________________
10. What is the land capability class of field number 4? __________________

ASSIGNMENT SHEET #4
CONSERVATION PLAN MAP *(only part of map shown)*

Owner *Darold Hehn* Operator *same* Date *6/90*

County/Parish *Tillman* State *SD* Appx. acres *2320* Appx. scale *1"=1320'*

Cooperating with *Tillman Conservation* District Assisted by *Mary Kellum* USDA-SCS



② Cropland 46Ac III el
③ Cropland 72 Ac III el
④ Crop-land 37 Ac. IV el
⑤ Rangeland 284 Ac. Si/Ac
SW-60% SWG-40% / GC
CV/FC
⑥ Cropland 64 Ac III el
⑦ Range-land 40 Ac. CV-30% CP-10% SY-20% Si-10%
⑧ Rangeland 96 Ac Si/GC
⑨ Cropland 36 Ac III el
⑩ Hayland 34 AC
⑪ Rangeland
SY
⑭ Crop-land 26AC
III el
Rangeland
⑮ 20AC
⑯ Rangeland 184 AC
SW-60% SWG-40% / GC
SY/GC
CY/GC
CY/GC
⑰ Hay-land 25AC
⑱ Hay-land 15AC TO SEED F
⑲ Past-land 18AC TO SEED F
⑳ Past land 18AC III el
㉑ Crop-land 23AC IV el
㉒ Rangeland 80AC
Cp-30% SY-20% Si-30% CY-20% / GC
㉖ Cropland 327 AC
㉗ Hayland 19AC F

LAND MANAGEMENT
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 1

2. 79164

3. a. 44
   b. 2.4
   c. 8
   d. 730
   e. 7.6
   f. Fine

4. a. High
   b. Low
   c. High
   d. Low

Assignment Sheet #2

LAND USE PLANNING SUMMARY

Cooperator ______________ Acres 285 ______ CD ______

Assisted by ______________________________ Date ______

Field	Acres	Land Use					Planned Practices
		Hay Land	Wild Life	Farm Stead	Range Land	Pasture Land	
1	37	37					
2	16	16					To Seed 1990
3	2			2			
4	47		47				Brush Control 1991
5	138				138		Cross Fence 1992
6	45					45	To Seed 1990
Total	285						

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #3

1. a. CeB
   b. Rs
   c. CeA
   d. Bp

2. Southeast

3. CeA

4. Rs

5. CeA

Assignment Sheet #4

1. Tillman

2. Mary Kellum

3. 46

4. Rangeland

5. III

6. To Seed

7. Cropland

8. Darold Hehn

9. 25

10. IV

LAND MANAGEMENT
UNIT III

JOB SHEET #1 — TAKE A LAWN AND GARDEN SOIL SAMPLE

EVALUATION CRITERIA

Criteria	Rating
Demonstrated proper use of equipment	______
Properly chose sampling spots	______
Properly mixed samples	______
Correctly filled out soil sample sheet	______

A. Tools and materials

1. Soil tube, soil auger, garden trowel, or spade
2. Plastic bucket
3. Soil sampling information sheet provided by instructor

B. Procedure

1. Scrape away any surface mat of grass or litter.
2. Sample the lawn and garden areas to the depth indicated below.

    a. Existing grass = 0-3 inches
    b. For new grass = 0-6 inches
    c. Gardens = 0-6 inches
    d. Trees and shrubs = 0-12 inches

    (NOTE: Avoid taking samples in areas like borders, low spots, near trees, or near buildings.)

3. Place the soil in a clean bucket or pan.
4. Sample in at least 10 spots within the area.
5. Mix samples of soil well to make a composite sample.
6. If samples are wet, air dry before placing in soil sample container.
7. Fill out the soil sample information sheet provided by your instructor. An example is shown on the next page.
8. Enclose the information sheet and the soil sample in a sturdy carton.
9. Send the package to the soil testing laboratory.

LAWN AND GARDEN SOIL SAMPLING INFORMATION SHEET

PRESS HARD! You are making three copies. Read the instructions on the back. Fill in as completely as you can.

Soil Testing Laboratory, South Dakota State University
Brookings, SD 57007

Date received ____________

Date ____________ **19**____ **Name** ____________ **Address** ____________ **Zip** ____________

Extra copy sent to: Name ____________ **Address** ____________ **Zip** ____________

JOB SHEET #1

Soil Sample						Tests Desired (✓)								
No. on bag	Lab number (do not write below, for lab use only)	Depth of sampling	County	**Type of sample taken** (new lawn, established lawn, vegetable garden, flower garden, fruit trees, shrubs, golf tees, greens, fairways, etc.)	check if area is watered regularly	Regular Tests	Zinc	Iron	Manganese	Copper	Calcium Magnesium	Sulfur	Lime need	Boron
					Charges per sample	$7.00	3.00	3.00	3.00	3.00	6.00	7.00	6.00	7.00

*Includes Nitrate-nitrogen, organic matter, phosphorus, potassium, pH, soluble salts, texture class. (for the vast majority of South Dakota soils, the regular series of tests will be sufficient.

Indicate special problems or comments. Note if shading, weeds, insects, diseases, water, etc., are a problem. List vegetables, grasses, fruits, flowers, trees and shrubs of special interest.

Sketch area(s) sampled for your information.

PC 063

Sampling Instructions on Back
Send all three copies with sample. The original will be returned to you.

Do Not Detach

145

144

LAND MANAGEMENT
UNIT III

JOB SHEET #2 — PERFORM A SOIL TEST TO DETERMINE ORGANIC MATTER

EVALUATION CRITERIA

Criteria	Rating
Properly mixed samples	_____
Correctly observed results of test	_____
Practiced safety rules throughout procedure	_____

A. Tools and materials

1. Test tube and stopper
2. Sodium hydroxide
3. Water
4. Test tube rack
5. Spoon
6. Eye dropper
7. Redco Science Kit "What's In a Soil" provided by instructor
8. Soil for testing

B. Procedure

1. Add one level spoonful of soil to test tube.
2. Add two droppersful of sodium hydroxide to the tube.
3. Add two droppersful of water to the tube.
4. Shake the tube well and place it in a test tube rack.
5. Let tube set for a day.
6. Observe the color of liquid and check your results below.

☐ Pale yellow color — Indicates a small amount of organic material

☐ Orange to brown color — Indicates presence of a large amount of organic materials

LAND MANAGEMENT
UNIT III

JOB SHEET #3 — DETERMINE PERCENT OF SOIL PARTICLES

EVALUATION CRITERIA

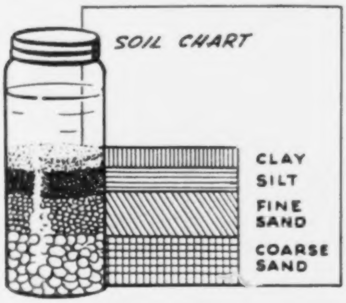
Criteria	Rating
Properly mixed soil sample	______
Correctly labeled layers	______

A. Tools and materials

1. Glass jar with lid
2. Soil sample
3. Water
4. Paper and pencil(s) or markers

B. Procedure

1. Fill the jar to half full with soil.
2. Fill the jar to three-fourths full with water.
3. Shake the mixture vigorously until soil is in suspension.
4. Allow the mixture to settle and observe the soil separation.
5. After a twenty-four-hour period of time, place a sheet of paper next to the jar and mark the different soil particle layers.



Courtesy of USDA Soil Conservation Service

6. Estimate the percent of each soil particle layer.

LAND MANAGEMENT
UNIT III

TEST

NAME ______________________________ SCORE ________________

1. Match the terms on the right with the correct definitions.

_____a. The wearing away of land surface

_____b. Highly decomposed plant and animal residue that is a part of soil

_____c. The planning and implementation of practices applied to the land

_____d. An organic or inorganic material that is added to the soil to supply elements essential to plant growth

_____e. A soil material that contains relatively equal amounts of sand, silt, and clay particles

_____f. An imaginary line along the ground connecting all points of the same elevation

_____g. The systematic examination, description, classification, and mapping of soils in an area

_____h. The actions that cause the breakdown of rock to form soil

_____i. The downward movement of water into the soil

_____j. The suitability of land for use without permanent damage

_____k. A living barrier of trees and shrubs designed for protection from wind and/or snow

_____l. The ability of the soil to allow air and water to move through it

_____m. The outer portion of the earth's crust that supports plant life

_____n. The angle of the soil surface expressed as a percent of rise and fall

1. Bacteria
2. Compaction
3. Contour
4. Erosion
5. Fertilizer
6. Flood hazard
7. Humus
8. Inert material
9. Land capability class
10. Land management
11. Loam
12. Percolation
13. Permeability
14. Reclamation
15. Slope
16. Soil
17. Soil survey
18. Texture
19. Weathering
20. Windbreak

TEST

2. Complete the following statements concerning how soils are formed by filling in the blanks. Choose from the following list (not all are needed):

Acids, animals, bacteria, larger, plants, rock, smaller, types, weathering

a. Soil starts out as __________.

b. __________ factors work to break rocks down.

c. Soil __________ are based upon the kind of rock from which it is made.

d. Small __________ begin to grow within the rock particles.

e. As more organic matter is formed, __________ plant forms take root.

f. __________ and fungi freak down the organic matter into simpler nutrients that are released into the soil.

3. Match the types of rocks on the right with the correct definitions.

______a. Formed by hardening of molten volcanic materials

______b. Formed as a result of changes in other rocks under heat and pressure

______c. Formed by a consolidation of particles laid down over the years

1. Igneous
2. Sedimentary
3. Metamorphic

4. List three types of weathering factors.

a. ____

b. ____

c. ____

5. Match the types of soils on the right with the ways they are deposited.

______a. Deposited by glaciers

______b. Deposited by moving fresh water

______c. Deposited by wind

1. Alluvial soil
2. Glacial soils
3. Loess soils

TEST

6. Distinguish among the major soil texture classes by placing the following letters next to the correct descriptions:

A — Sand
B — Silt
C — Clay

______a. A fine-textured soil

______b. A coarse-textured soil

______c. Grains can easily be seen and felt.

______d. Feels smooth and talc-like when wet

______e. When dry, will fall apart

______f. Has low permeability rate

7. Select from the following list the composition of an average soil.

______a. Water 50%, air 10%, organic matter 10%, mineral matter 30%

______b. Water 25%, air 50%, organic matter 10%, mineral matter 15%

______c. Water 25%, air 25%, organic matter 5%, mineral matter 45%

______d. Water 25%, air 25%, organic matter 25%, mineral matter 25%

8. Select from the following list the functions of organic matter. Place an "X" next to the correct functions.

______a. Provides food for soil microorganisms

______b. Makes water in the soil

______c. Stores soil moisture

______d. Makes soil more tillable

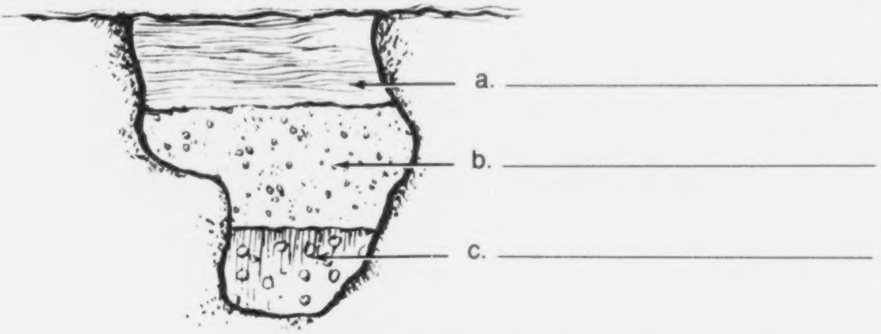
______e. Returns plant nutrients to the soil

______f. Serves as a cementing agent for soil particles

______g. Eliminates air in the soil

TEST

9. Identify the three horizons of a soil profile.



10. Match the land capability classes on the right with the correct definitions.

______a. Soils suited only for recreation, wildlife, water supply, or aesthetic purposes

______b. Soils that can be used for cultivated crops but require proper land management

______c. Soils unsuited for cultivated crops and restricted largely to grazing, woodland, or wildlife

1. Class I-IV
2. Class V-VII
3. Class VIII

11. Select true statements concerning soil testing by indicating "T" or "F" if the statement is true or false.

______a. Soils differ in the amount of nutrients they can supply to plants.

______b. A soil test will determine the exact amount of nutrients a soil can provide.

______c. Adding major plant nutrients based on a soil test can increase yield and will improve quality of the plant.

12. Distinguish between major and minor plant nutrients by placing an "X" next to the major nutrients.

______a. Zinc

______b. Iron

______c. Potassium

______d. Sulfur

______e. Chlorine

______f. Nitrogen

TEST

______g. Copper

______h. Phosphorus

13. Identify the nutrients in the following fertilizer analysis:

$$\begin{array}{ccccc} 10 & — & 20 & — & 10 \\ \uparrow & & \uparrow & & \uparrow \\ \text{a.} & & \text{b.} & & \text{c.} \end{array}$$

a. ______________________________

b. ______________________________

c. ______________________________

14. Select true statements concerning soil survey reports by placing a "T" or "F" by the true or false statements.

______a. Soil survey reports contain aerial photograph maps for an entire state.

______b. Soil survey reports give descriptions of soils in a county.

______c. They list management information to assist in land use planning.

15. List the types of erosion.

a. ______________________________

b. ______________________________

16. List two causes of erosion.

a. ______________________________

b. ______________________________

17. Complete the following statements concerning the effects of erosion by circling the correct words.

a. (Reduces, Increases) fertility of land.

b. (Reduces, Increases) sediment in reservoirs and ponds.

c. (Decreases, Increases) water filtration expenses.

d. (Helps, Destroys) spawning beds of game fish.

e. (Reduces, Increases) fish food supply.

f. (Increases, Decreases) the damage caused by floods.

TEST

18. Select from the following list the contributors to erosion pollution by placing an "X" next to the correct contributors.

______a. Riverbank erosion

______b. Farming erodible lands

______c. Unprotected construction sites

______d. Grassed waterway

______e. Industrial and mining activities

19. List four methods of controlling erosion on the farm.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

20. List four methods of controlling urban erosion.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

21. List five stewards of the soil.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

TEST

22. Match the Conservation Provisions of the 1985 Farm Bill on the right with the correct descriptions.

______a. Discourages farmers from converting wetlands to croplands

______b. Requires farmers to develop and begin actively applying an approved conservation plan for highly erodible cropland

______c. Discourages farmers from planting on new highly erodible land without a conservation plan

______d. Offers producers help in retiring highly erodible cropland

1. Conservation Reserve
2. Conservation Compliance
3. Cropbuster
4. Swampbuster
5. Sodbuster

23. List four parts of a conservation plan.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

24. Select true statements concerning reclamation of mined lands by placing a "T" or "F" indicating if the statement is true or false.

______a. Surface strip-mines are required to have a reclamation plan.

______b. Oxygen is a mineral resource obtained by surface mining.

______c. Surface mining can be harmful to land.

______d. Surface mining causes rivers and streams to become choked with sediment.

______e. As water drains through the mines, it becomes purified.

______f. To reclaim mined lands, earth-moving equipment is used to fill the mined area with rock debris, the land is shaped, topsoil is spread, and trees, shrubs, and a mixture of grass are planted.

______g. Sand and gravel are mined by surface mines.

TEST

25. List two land management careers.

    a. ______________________________

    b. ______________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

26. Read a soil test report. (Assignment Sheet #1)

27. Complete a land use planning summary. (Assignment Sheet #2)

28. Read a soil survey map. (Assignment Sheet #3)

29. Read a conservation plan. (Assignment Sheet #4)

30. Demonstrate the ability to:

    a. Take a lawn and garden soil sample. (Job Sheet #1)

    b. Perform a soil test to determine organic matter. (Job Sheet #2)

    c. Determine percent of soil particles. (Job Sheet #3)

LAND MANAGEMENT
UNIT III

ANSWERS TO TEST

1. a. 4
   b. 7
   c. 10
   d. 5
   e. 11
   f. 3
   g. 17
   h. 14
   i. 12
   j. 9
   k. 20
   l. 13
   m. 16
   n. 15

2. a. Rock
   b. Weathering
   c. Types
   d. Plants
   e. Larger
   f. Bacteria

3. a. 1
   b. 3
   c. 2

4. Any three of the following:

   a. Temperature changes
   b. Winds
   c. Water
   d. Chemicals
   e. Ice
   f. Glaciers

5. a. 2
   b. 1
   c. 3

6. a. C
   b. A
   c. A
   d. B
   e. A
   f. C

7. c

8. a, c, d, e, f

ANSWERS TO TEST

9. a. Topsoil
   b. Subsoil
   c. Parent material

10. a. 3
    b. 1
    c. 2

11. a. T
    b. F
    c. T

12. c, f, h

13. a. Nitrogen
    b. Phosphorus
    c. Potassium

14. a. F
    b. T
    c. T

15. a. Wind
    b. Water

16. Any two of the following:

    a. Moving water
    b. Topography including slopes
    c. Lack of vegetation
    d. Dry climate conditions
    e. Wind
    f. Human activities

17. a. Reduces
    b. Increases
    c. Increases
    d. Destroys
    e. Reduces
    f. Increases

18. a, b, c, e

ANSWERS TO TEST

19. Any four of the following:

    a. Plant buffer strips of perennial grasses to hold soil particles.
    b. Plant windbreaks to slow wind speeds.
    c. Ridge soil into small furrows to trap soil particles.
    d. Provide diversions to channel excess runoff.
    e. Farm on the contour rather than straight-row.
    f. Terrace to control and manage water runoff.
    g. Use contour stripcropping.
    h. Use rotation cropping.
    i. Practice conservation tillage, which leaves all or a portion of the previous crop's residue on the soil surface after planting.
    j. Use tile drainage to remove excess underground water.
    k. Use grassed waterways to channel excess runoff.
    l. Mulch to hold soil in place.
    m. Prevent overgrazing of pastures and rangelands.
    n. Use field borders of perennial vegetation to protect field edges.

20. Any four of the following:

    a. Plant trees.
    b. Plant grass and ground covers.
    c. Place rock materials (rip-rapping) along riverbank.
    d. Leave vegetation on the soil as long as possible.
    e. Disturb only the minimum of the construction area.
    f. Cover bare spots with grasses, mulch, etc.
    g. Use erosion blankets or netting during construction or while waiting for grass seed to sprout.
    h. Protect slope from failure by using matting, grass, etc.
    i. Use stormwater diversions, berms, etc. to channel or slow down runoff.
    j. Base building plans on scientific soil surveys.

21. Any five of the following:

    a. Private landowners
    b. Land-grant colleges
    c. Cooperative Extension Service
    d. Agricultural experiment stations
    e. High school agriculture education programs
    f. Youth organizations — 4-H, FFA
    g. Soil Conservation Service
    h. Forest Service
    i. Bureau of Land Management
    j. Bureau of Indian Affairs
    k. Agricultural Stabilization and Conservation Service
    l. Corps of Engineers
    m. State and district soil and water conservation offices

ANSWERS TO TEST

22. a. 4
    b. 2
    c. 5
    d. 1

23. Any four of the following:

    a. Soil map
    b. Land use
    c. Soil type and symbols
    d. Acres
    e. Capability class
    f. Slope
    g. Planned conservation treatment

24. a. T
    b. F
    c. T
    d. T
    e. F
    f. T
    g. T

25. Any two of the following:

    a. Soil conservationist
    b. Soil conservation technician
    c. Soil scientist
    d. Soil engineer

26.-29. Evaluated to the satisfaction of the instructor

30. Performance skills evaluated to the satisfaction of the instructor

AIR RESOURCE MANAGEMENT
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to describe sources of air pollutants, health effects of air contaminants, and solutions to air pollution problems. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to air resource management with the correct definitions.
2. State the composition and percentages of air components.
3. Complete a chart of air pollutants and health hazards associated with each.
4. Complete statements concerning environmental effects of air pollution.
5. Select true statements concerning indoor air pollution.
6. Match indoor air pollutants with the correct descriptions.
7. Select true statements concerning air quality regulations.
8. Name methods of controlling motor vehicle emissions.
9. List methods of controlling air pollution from industry and electric power generating plants.
10. Complete statements concerning progress made from 1976 to 1986 in controlling air pollution.
11. Discuss global considerations in air resource management.
12. List careers in air resource management.
13. Locate sources of air pollution in your area. (Assignment Sheet #1)
14. Write a report on a global environmental problem related to air resource management. (Assignment Sheet #2)
15. Collect and report results from air monitoring equipment. (Assignment Sheet #3)

AIR RESOURCE MANAGEMENT
UNIT IV

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Air Pollutants — Objective 3

TM 2-5 — Environmental Effects of Air Pollution — Objective 4

TM 6 — Indoor Air Pollution — Objectives 5 and 6

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. From a garage or salvage yard, obtain a catalytic converter and cut it open to show a cross section.
2. Have a state health department employee bring to class and demonstrate air sampling equipment. This equipment is usually set up and left in place for several days; therefore, the students can use the equipment as part of Assignment Sheet #3 to test for pollen, mold, and particulates.
3. Discuss careers in air resource management.
4. Arrange for a test of the school facilities or student homes for the concentration of radon gas. Contact your state health department for more information.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Stein, Arthur C., et. al. *Fundamentals of Air Pollution.* New York: Academic Press.

B. Moran, Joseph M., et. al. *Introduction to Environmental Science.* W. H. Freeman and Company, 1980.

C. U.S. Environmental Protection Agency, Office of Air and Radiation. *The Inside Story — A Guide to Indoor Air Quality.* Washington, D.C. 20460.

D. U.S. Environmental Protection Agency, *EPA Journal*, Vol 12 — "Acid Rain: Looking Ahead". Office of Public Affairs (A-107) Washington, D.C. 20460.

E. Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources.* Albany, NY: Delmar Publishers, Inc., 1988.

F. U.S. Environmental Protection Agency. *Environmental Progress and Challenges: EPA's Update*, 1988.

SUGGESTED SUPPLEMENTAL RESOURCES

Films and videotapes

A. *Acid Rain.* 20 min., VHS or Beta. Provides chemical definitions and traces sources of acid precipitation.

B. *Air Pollution: Outdoor.* 26 min., VHS or Beta. Examines air pollutants and research into new and cleaner fuels.

C. *Air Pollution: Indoor.* 26 min., VHS or Beta. Discusses air pollutants in a home.

A-C are available from:

Films for the Humanities and Sciences
P.O. Box 2053
Princeton, NJ 08543
800/257-5126

D. *Air is Life.* 15 min., 16 mm or video. Air pollution studied from a global perspective. Available from:

International Film Bureau, Inc.
332 South Michigan Ave.
Chicago, IL 60604-4382
312/427-4545

Air Pollutants

Health Effects of the Regulated Air Pollutants

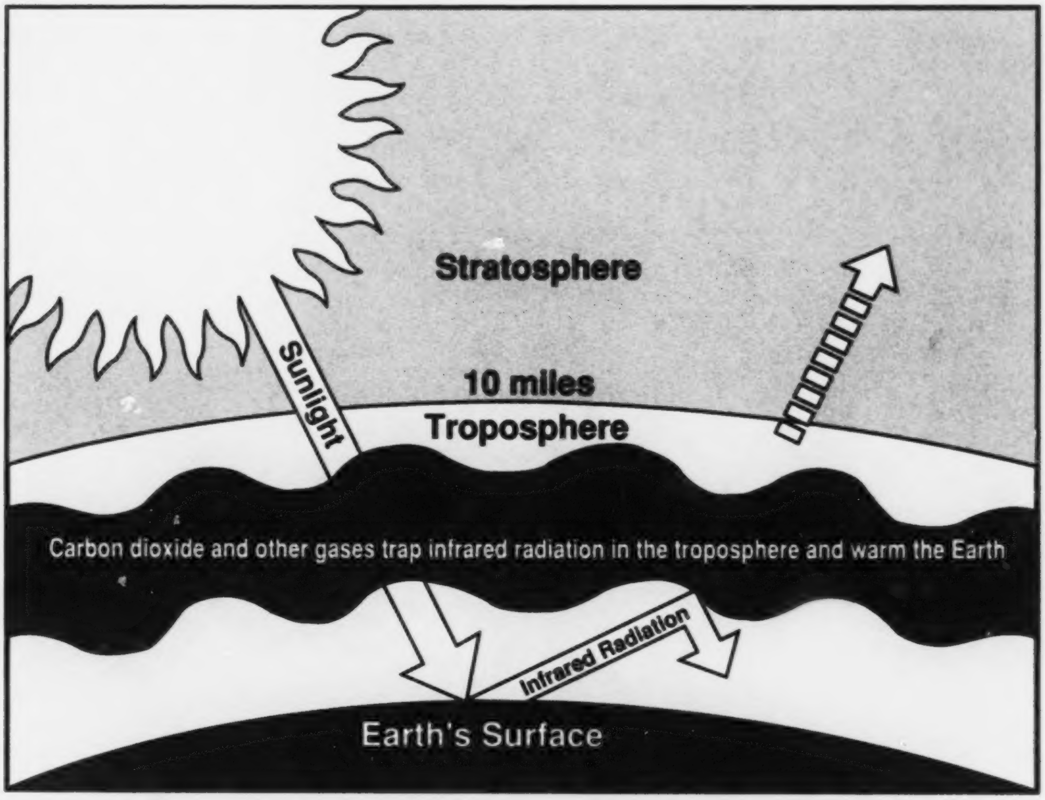
Criteria Pollutants	**Health Concerns**
Ozone	Respiratory tract problems such as difficult breathing and reduced lung function. Asthma, eye irritation, nasal congestion, reduced resistance to infection, and possibly premature aging of lung tissue.
Particulate Matter	Eye and throat irritation, bronchitis, lung damage, and impaired visibility.
Carbon Monoxide	Ability of blood to carry oxygen impaired. Cardiovascular, nervous, and pulmonary systems affected.
Sulfur Dioxide	Respiratory tract problems; permanent harm to lung tissue.
Lead	Retardation and brain damage, especially in children.
Nitrogen Dioxide	Respiratory illness and lung damage.

Hazardous Air Pollutants — No level is safe.

Asbestos	A variety of lung diseases, particularly lung cancer.
Beryllium	Primarily lung disease, although also affects liver, spleen, kidneys, and lymph glands.
Mercury	Several areas of the brain as well as the kidneys and bowels affected.
Vinyl Chloride	Lung and liver cancer.
Arsenic	Causes cancer.
Radionuclides	Causes cancer.
Benzene	Leukemia
Coke Oven Emissions	Respiratory cancer

Information provided by U.S. Environmental Protection Agency.

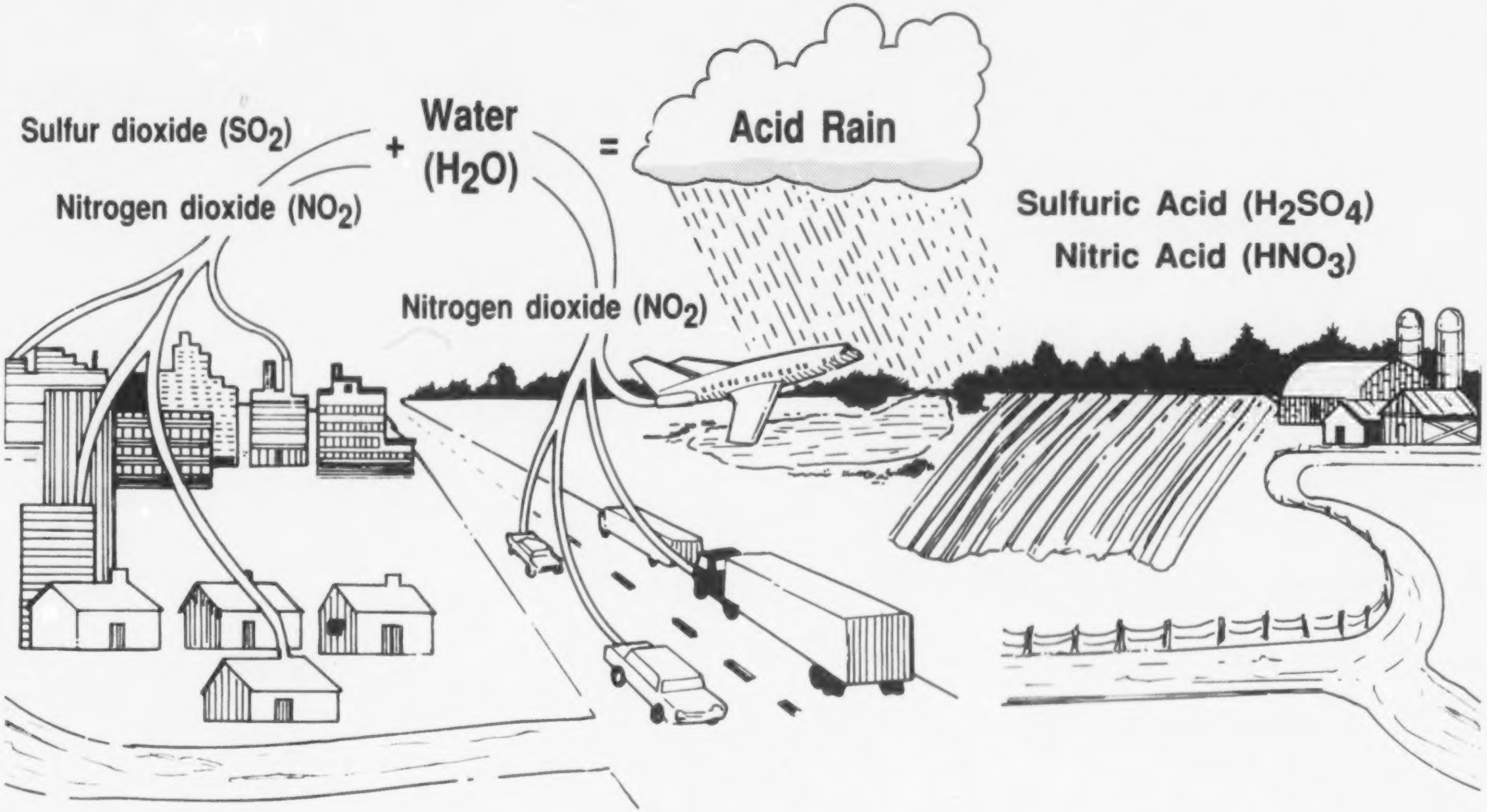
Greenhouse Effect


Stratosphere
Sunlight
10 miles
Troposphere
Carbon dioxide and other gases trap infrared radiation in the troposphere and warm the Earth
Infrared Radiation
Earth's Surface

The Greenhouse Effect Traps Solar Heat

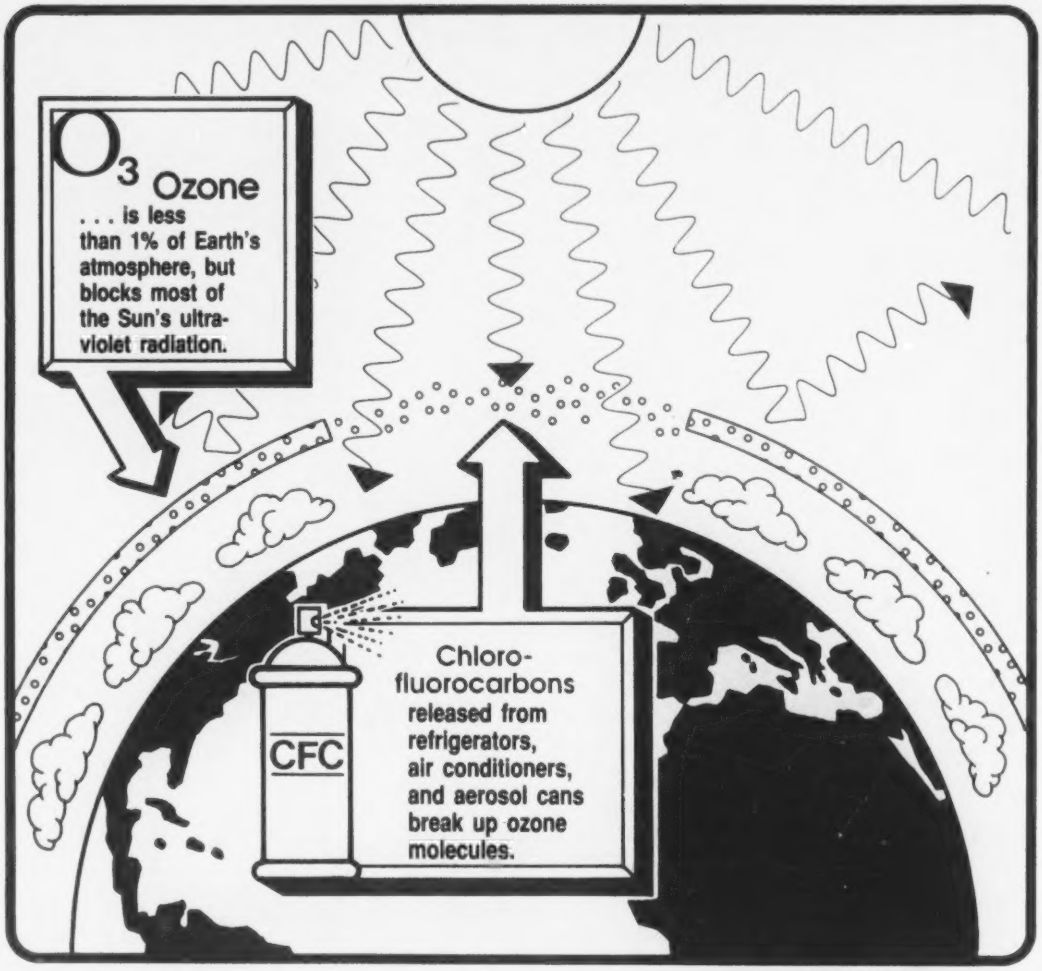
Courtesy of U.S. Environmental Protection Agency

Acid Rain

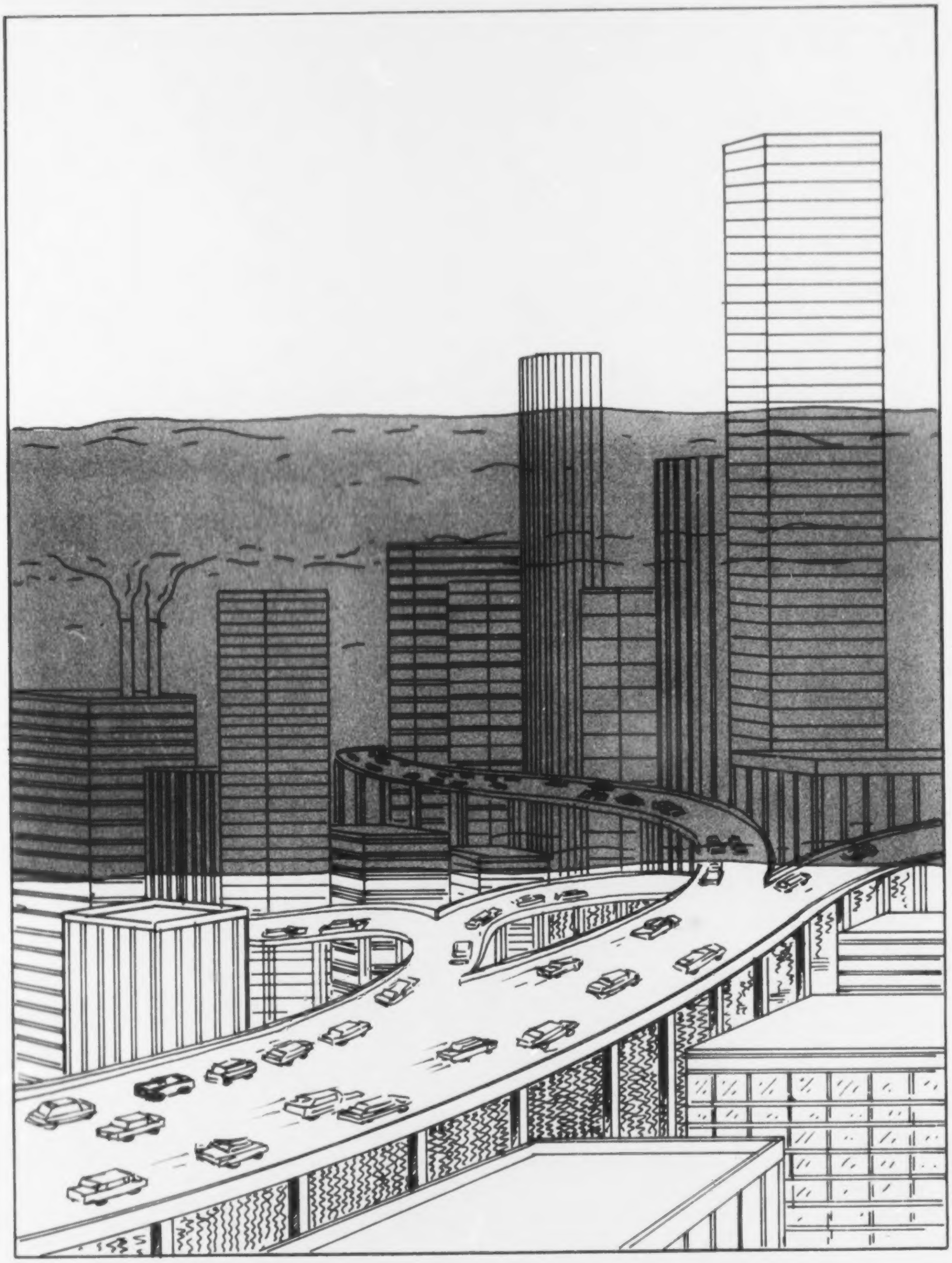

Sulfur dioxide (SO_2)
Nitrogen dioxide (NO_2)
+
Water
(H_2O)
=
Acid Rain
Sulfuric Acid (H_2SO_4)
Nitric Acid (HNO_3)
Nitrogen dioxide (NO_2)

TM 3

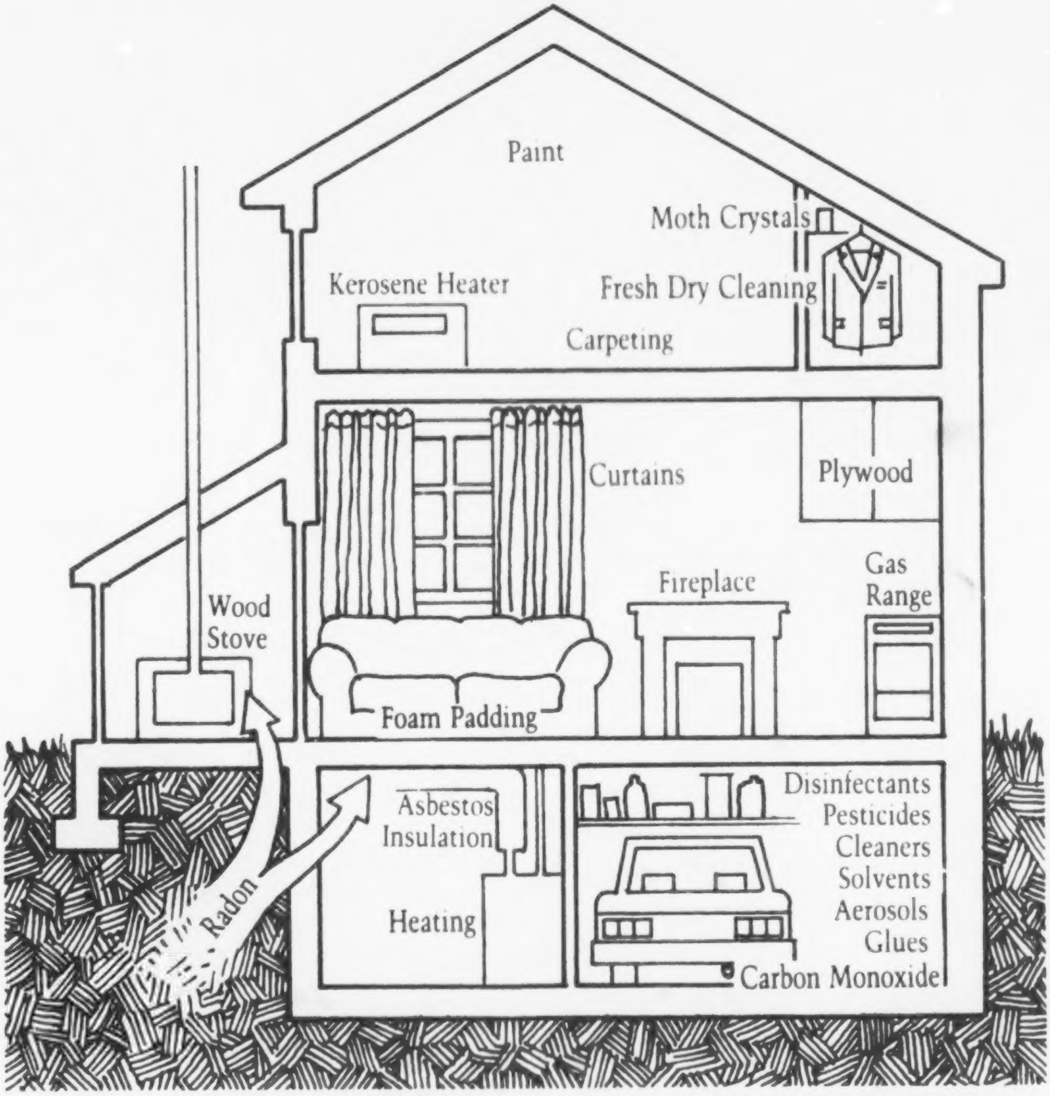
Ozone Shield


O_3 Ozone
. . . is less than 1% of Earth's atmosphere, but blocks most of the Sun's ultraviolet radiation.
CFC
Chlorofluorocarbons released from refrigerators, air conditioners, and aerosol cans break up ozone molecules.

Smog



Indoor Air Pollution


Paint
Moth Crystals
Kerosene Heater
Fresh Dry Cleaning
Carpeting
Curtains
Plywood
Gas Range
Fireplace
Wood Stove
Foam Padding
Asbestos Insulation
Heating
Radon
Disinfectants
Pesticides
Cleaners
Solvents
Aerosols
Glues
Carbon Monoxide

Courtesy of U.S. Environmental Protection Agency

AIR RESOURCE MANAGEMENT
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Air — A mixture of invisible, odorless, tasteless gases that surround the earth

B. Air pollution episode — Abnormally high concentrations of air pollutants

(NOTE: This is usually due to low winds and temperature inversions.)

C. Ambient air — Any unconfined portion of the atmosphere; the outside air

D. Atmosphere — The mass of air surrounding the earth held by the force of gravity

E. Emission — Pollutant discharged into the air

F. Inversion — An atmospheric condition where a layer of cool air is trapped by an upper layer of warm air

G. National ambient air quality standards (NAAQS) — The level of pollutants in the outside air that by law cannot be exceeded during a specified time in a specified geographical area

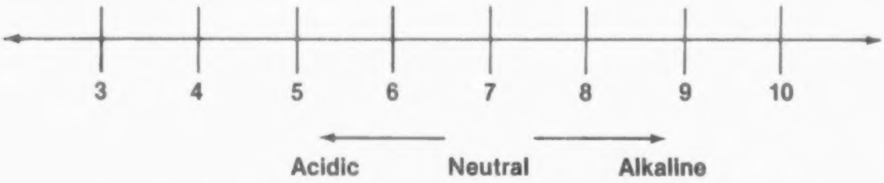
H. Organic compounds — Compounds composed of chemicals containing carbon

Examples: Pesticides, solvents, cleaning compounds, paints

I. pH — A scale which represents alkalinity or acidity

(NOTE: The pH scale ranges from 0 to 14 with 7 being neutral, below 7 acidic, and above 7 alkaline.)

pH Scale



J. Pollutant — Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose

K. Pollution — The presence of matter or energy whose nature, location, or quantity produces undesirable environmental effects

L. Population density — The number of people per unit area

Example: People per square mile

INFORMATION SHEET

M. Respiratory system — Organs such as the throat, lungs, and air channels which supply oxygen to air-breathing vertebrates

N. Scrubber — An air pollution control device that uses a liquid spray to remove pollutants from a gas stream (as in a smoke stack); also lowers the temperature of the emission

O. Stagnation — Lack of wind in an air mass

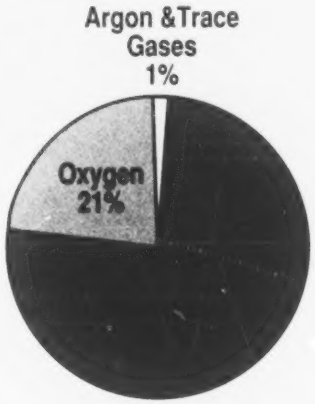
(NOTE: This tends to trap and concentrate pollutants.)

II. Composition and percentages of air components (unpolluted)

A.	Nitrogen	78%
B.	Oxygen	21%
C.	Argon	0.9%

D. Trace amounts of the following gases:

- Carbon dioxide
- Neon
- Helium
- Methane
- Krypton
- Nitrous oxide
- Hydrogen
- Xenon
- Organic vapors



III. Air pollutants and their health hazards

Air Pollutants	Health Hazards
A. **Particulate matter**	
1. Finely divided solid or liquid particles in the air or in an emission such as dust, smoke, and fumes	Contributes to eye and throat irritation, bronchitis, lung damage, and impaired visibility
2. Caused by steel mills, power plants, cement plants, grain elevators, dirt roads, fireplaces, agricultural burning, and forest fires	

INFORMATION SHEET

	Air Pollutants	Health Hazards
B.	**Ozone** (O_3)	
	1. A pungent, colorless, toxic gas	Serious respiratory problems such as breathing difficulties, asthma, reduced lung function, eye irritation, nasal congestion, and reduced resistance to infection
	2. Produced when sunlight hits air pollutants such as volatile organic compounds (VOCs) and nitrogen oxides which are released from fossil fuel combustion (primarily vehicles)	
	3. Major component of smog	
C.	**Carbon monoxide** (CO)	
	1. A colorless, odorless, highly toxic gas. Can be deadly in small quantities if breathed over a certain period of time	Impairs ability of blood to carry oxygen; affects heart, lung, and nervous systems
	2. Is produced by incomplete fossil fuel combustion, primarily in motor vehicles.	
D.	**Sulfur dioxide** (SO_2)	
	1. A heavy, pungent, colorless gas	Respiratory tract problems (acute and chronic); permanent damage to lung tissue
	2. Formed primarily through the burning of coal, fuel oils, and wood	
	3. Major contributor to acid rain	
E.	**Nitrogen dioxide** (NO_2)	
	1. An invisible gas produced when oxygen in the air combines with nitric oxide that is produced by fossil fuel combustion, primarily in motor vehicles	Respiratory illness and lung damage
	2. Major contributor to smog and acid rain	

INFORMATION SHEET

	Air Pollutants	Health Hazards
F.	**Lead** (Pb) (Airborne)	
1.	Exists in particles small enough to be carried by air currents	Causes brain damage and serious physical and mental impairment, especially in children
2.	Generated primarily by automobile using leaded gasoline	

IV. **Environmental effects of air pollution**

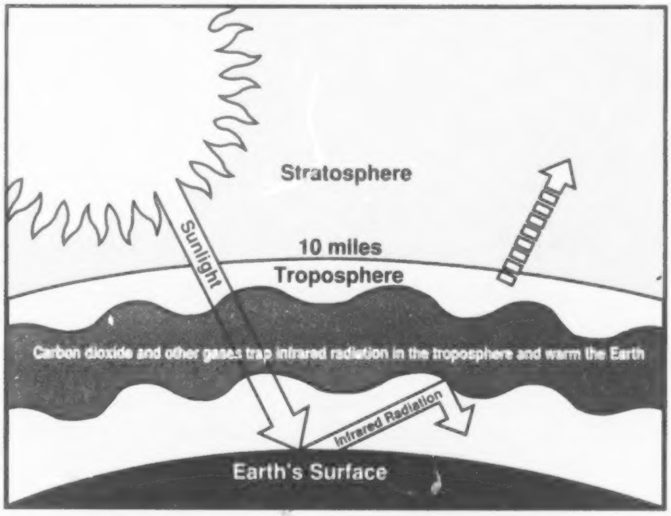
A. **Greenhouse effect**

1. The greenhouse effect traps heat from the sun.

   a. A layer of carbon dioxide and other gases above the earth's surface acts like a glass on top of a greenhouse

   b. Heat radiated from the sun passes through the carbon dioxide layer.

   c. Part of the heat is trapped by the carbon dioxide layer; the rest is radiated back to the atmosphere.


Stratosphere
Sunlight
10 miles
Troposphere
Carbon dioxide and other gases trap infrared radiation in the troposphere and warm the Earth
Infrared Radiation
Earth's Surface

   d. Many scientists believe that an increase in the atmospheric concentration of carbon dioxide can eventually cause an increase in the earth's surface temperature — global warming.

INFORMATION SHEET

2. Effects of global warming

    a. Sea levels will rise due to the melting of polar ice caps and the expansion of heated oceans

    b. As sea levels rise, coastal areas will erode and be covered by water.

    (NOTE: Sea levels are predicted to rise over a foot in the next 30 years and 3 to 7 feet by the year 2100.)

    c. Natural ecosystems would be greatly affected.

    d. The excess heat would make many agricultural areas arid and nonproductive.

3. Causes of the greenhouse effect — Increased carbon dioxide concentrations from

    a. Burning fossil fuels

    b. Burning organic matter (plants and animal waste)

    c. Burning forests (deforestation)

    (NOTE: When trees and plants that use carbon dioxide are destroyed, excess carbon dioxide builds up.)

4. Solution to the problem.

    a. Use less fossil fuels.

    b. Reduce forest burning practices.

    c. Convert to nonfossil fuels such as nuclear, solar, and wind energy.

B. **Acid rain**

1. Acid rain is atmospheric moisture which absorbs acid particles and falls to the earth. It has a pH value of less than 5.6.

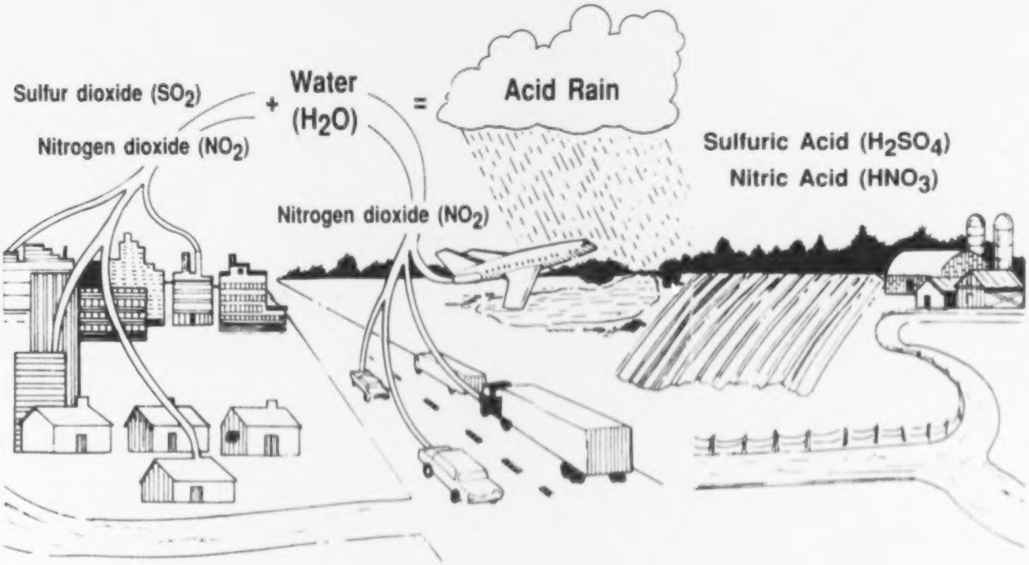
    a. The acid rain process begins with the emissions of sulfur dioxide and nitrogen dioxide from coal-burning electric power plants and automobile exhaust.

    b. Sulfur dioxide (SO_2) combines with water (H_2O) to produce sulfuric acid H_2SO_4.

    c. Nitrogen dioxide (NO_2) combines with water (H_2O) to produce nitric acid (HNO_3).

    d. Winds transport airborne acid particles hundreds of miles across state and national borders.

INFORMATION SHEET


Sulfur dioxide (SO_2)
Nitrogen dioxide (NO_2)
+
Water (H_2O)
=
Acid Rain
Sulfuric Acid (H_2SO_4)
Nitric Acid (HNO_3)
Nitrogen dioxide (NO_2)

2. Effects of acid rain

    a. Acid rain causes surface waters and soils to become more acidic.

    b. Acidic water disrupts the reproductive cycles of fish.

    c. Acid rain leaches metals from soils and harms fish, aquatic plants, and microorganisms when these metals reach lakes and streams.

    d. Acid rain adversely affects forests and agriculture.

3. Solution to the problem

    a. Burn less coal.

    b. Reduce automobile emissions.

    c. Convert to cleaner fuels such as nuclear, solar, or wind energy.

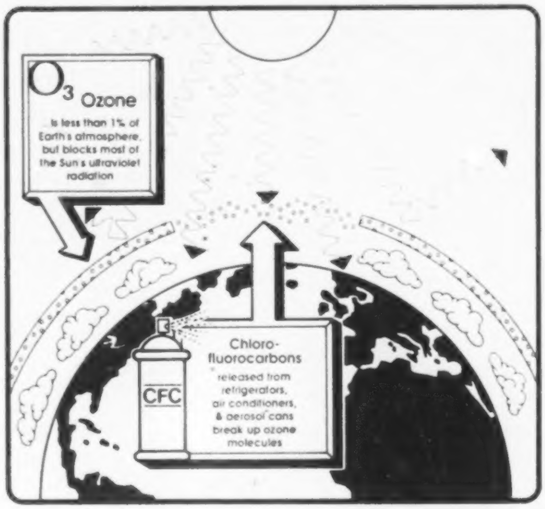
    d. Develop more efficient emission control devices.

C. **Ozone shield**

1. The ozone shield is a layer of ozone in the stratosphere 6 to 30 miles above the earth.

    a. The ozone shield protects all earth organisms from dangerous ultraviolet radiation from the sun.

INFORMATION SHEET


O3 Ozone
...is less than 1% of Earth's atmosphere, but blocks most of the Sun's ultraviolet radiation
CFC
Chloro-fluorocarbons
released from refrigerators, air conditioners, & aerosol cans break up ozone molecules

b. The ozone shield is being depleted by synthetic chemicals known as chlorofluorocarbons (CFCs).

c. CFCs are compounds consisting of chlorine, fluorine, and carbon which attack and destroy ozone molecules.

d. CFCs are used as agents for producing plastic foam, coolants for refrigerators and air conditioners, propellants for aerosol sprays, and cleansers for electrical parts.

(NOTE: Although most CFCs are now banned, the environmental effects are still present.)

e. Nitrogen oxides from combustion of fossil fuels also remove ozone from the stratosphere.

2. Effects of ozone shield depletion

a. As ozone is depleted, increased amounts of ultraviolet (U.V.) radiation from the sun strike the earth.

b. Increased U.V. radiation causes skin cancer, decreases crop yields, reduces fish populations, and contributes to smog.

3. Solution to the problem

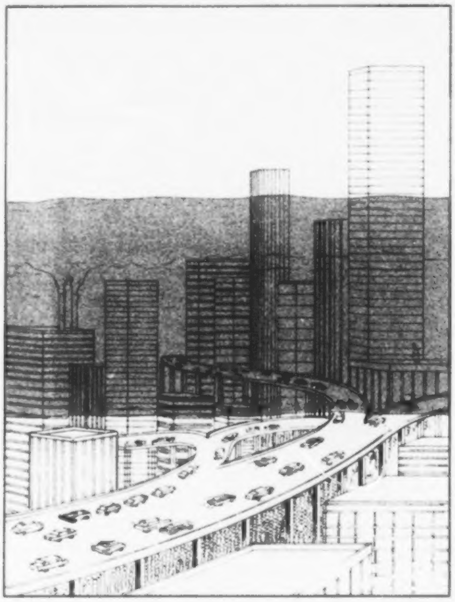
a. Reduce the use and disposal of CFCs.

b. Reduce nitrogen oxide emissions from fossil fuel combustion.

INFORMATION SHEET

D. Smog

1. Smog is a combination of **sm**oke and f**og** forming an atmosphere polluted with industrial emissions and automobile exhaust.

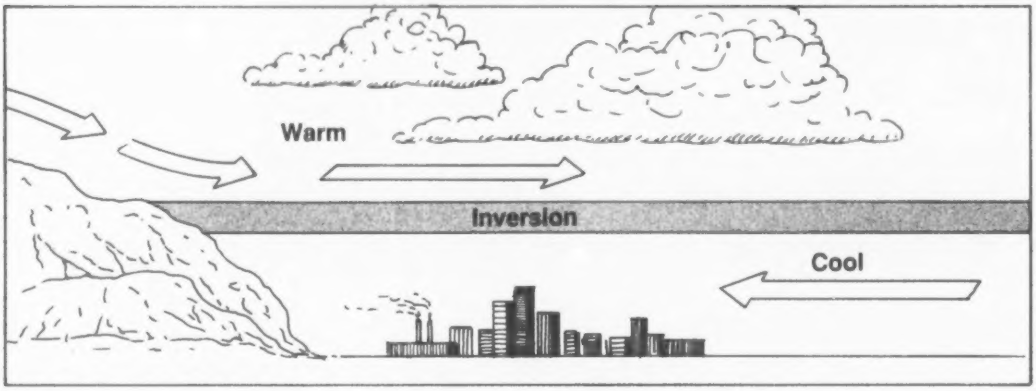


   a. Smog is generally confined to high population areas.

   b. Smog can be carried by winds and affect downwind rural areas.

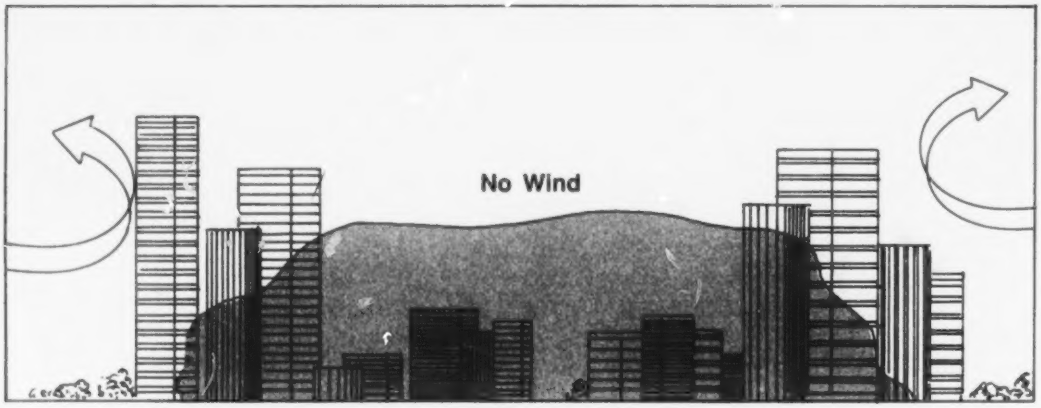
   c. Smog is more severe when accompanied by temperature inversions — When a layer of cool air is trapped by an upper layer of warm air.

   (NOTE: Inversions hold polluted air closer to the ground.)



INFORMATION SHEET

d. Smog is also more severe in stagnant air conditions where dilution by fresh air is minimized.



2. Effects of smog

   a. Trace heavy metals (lead, zinc, iron, cadmium) in smog cause serious health problems.

   b. Numerous deaths are reported each year from smog, especially among those with respiratory illnesses.

   c. People with respiratory problems are forced to stay indoors.

   d. Smog reduces visibility causing traffic accidents.

3. Solutions to the problem

   a. Improve automobile emission controls.

   b. Control industrial emissions.

   c. Convert to cleaner energy sources.

V. Indoor air pollution

A. Indoor air pollution is a major health problem in the U.S.

B. Indoor pollutant levels are frequently higher than outdoor concentrations.

C. Most people spend 90% of their time indoors.

Examples: At home, school, work, indoor social/recreational activities

D. Ventilation of buildings is important to reduce indoor pollution.

E. Newer homes and buildings, tightly constructed to conserve energy, are more likely to have air pollution problems.

INFORMATION SHEET

F. Short-term health effects of indoor air pollution

   1. Eye, ear, nose, and throat irritations
   2. Fatigue
   3. Headaches
   4. Irritability
   5. Forgetfulness
   6. Nausea

G. Long-term health effects

   1. Permanent respiratory damage
   2. Impairment of the nervous system
   3. Cancer

VI. Indoor air pollutants

A. Radon

   1. Radon is a naturally-occurring gas emitted from radioactive decay of the element radium.
   2. Radium is found in many types of rocks and soils.
   3. Radon enters buildings through foundation cracks or seams, floor drains, and slab joints.
   4. Radon is inhaled into the lungs, increasing the risk of lung cancer.
   5. Radon is estimated to cause between 5,000 and 20,000 deaths per year in the U.S.
   6. Radon cannot be seen or smelled. However, it can be detected with specialized equipment and laboratory analysis.
   7. Radon concentrations in buildings can be reduced in some situations.

B. Environmental tobacco smoke

   1. Environmental tobacco smoke is smoke that nonsmokers are exposed to in the environment.
   2. Tobacco smoke contains numerous pollutants such as gases, heavy metals, particulates, and products of incomplete burning.

INFORMATION SHEET

3. Environmental tobacco smoke can cause heart disease, lung cancer, and other health disorders.

4. It is estimated that from 500 to 5,000 nonsmoker deaths per year are caused by environmental tobacco smoke.

C. Formaldehyde and other organic compounds

1. Formaldehyde is found in furniture, foam insulation, and pressed wood products such as particle board.

2. Organic compounds are found in tobacco smoke, dry-cleaned clothes, paints, and cleaning compounds.

3. Health problems are eye and nose irritation and respiratory ailments.

4. Sources of these contaminants should be located and removed.

D. Biological pollutants

1. Heating and air conditioning systems can be breeding grounds for biological pollutants such as fungi, viruses, and bacteria.

2. Heating and air conditioning systems can bring outdoor biological contaminants such as pollen and mold inside.

3. Biological contaminants can cause viral infections and allergic reactions.

E. Pesticides

1. Pesticides are chemicals used to destroy pests.

2. Indoor and outdoor use of pesticides are responsible for indoor air pollution.

3. Even when used as directed, pesticides may pose a health threat.

4. Pesticide exposure may cause cancer, birth defects, and other chronic health problems.

F. Asbestos

1. Asbestos is a mineral fiber found in nature which is normally used for insulation.

2. Asbestos has been used in the past for fireproofing and soundproofing in ceiling and floor tiles.

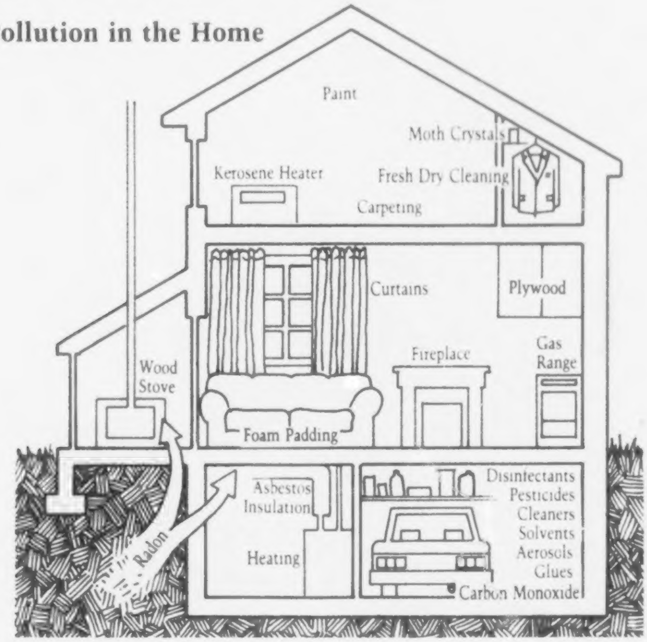
3. Asbestos fibers are extremely small and become airborne when separated from parent material.

INFORMATION SHEET

4. Asbestos fibers can be inhaled into the lungs or ingested in food or water.

5. Asbestos fibers are known to cause cancer.

Air Pollution in the Home


Paint
Moth Crystals
Kerosene Heater
Fresh Dry Cleaning
Carpeting
Curtains
Plywood
Wood Stove
Fireplace
Gas Range
Foam Padding
Asbestos Insulation
Heating
Radon
Disinfectants
Pesticides
Cleaners
Solvents
Aerosols
Glues
Carbon Monoxide

VII. Air quality regulations

A. 1955 — Provided funds for the Public Health Service to do research on polluted air.

B. 1963 — Clean Air Act passed which expanded federally-sponsored research and provided grants to states to develop air quality programs.

C. 1965 — Clean Air Act was amended to reduce carbon monoxide and other air pollutants.

D. 1967 — Air Quality Act passed which set goals for air quality and called for cooperation between state and federal governments to establish air quality standards.

E. 1970 — Clean Air Act amendments directed EPA to develop uniform air quality standards in 247 air quality regions. Also required states to enforce air quality standards for stationary facilities such as power plants and industry. Provided for stiff fines on violators.

F. 1977 — National Commission on Air Quality was established to evaluate federal laws concerning air quality.

INFORMATION SHEET

VIII. Methods of controlling motor vehicle emissions

A. Reduce the escape of hydrocarbons from carburetor and fuel systems.

B. Keep engines tuned.

C. Maintain emission control systems and catalytic converters.

D. Use lead-free gasoline.

E. Reduce sulfur compounds during refining of diesel fuel.

F. Use ethanol (grain alcohol) as a fuel.

G. Use methanol (wood alcohol) as a fuel.

IX. Methods of controlling air pollution from industry and electric power generating plants

A. Install equipment (scrubbers) to remove air contaminants from stack exhaust.

B. Remove pollutants from fuel sources such as sulfur from coal.

C. Use technologies which reduce contaminants in exhaust emissions.

D. Use coal with a low sulfur content.

E. Convert operations to fuels which produce less air pollutants such as solar, wind, and nuclear.

X. Progress made from 1976 to 1986 in controlling air pollution

A. Particulates (Total Suspended Particulates — TSP)

1. Particulate levels decreased 23%.
2. Decrease in particulate levels is due to installation of pollution control devices on sources of particulates.
3. Particulate levels in the atmosphere can be reduced further by improved pollution control devices.

B. Sulfur dioxide (SO_2)

1. Sulfur dioxide levels decreased 37%.
2. Decrease in sulfur dioxide is primarily due to pollution control devices installed on coal-fired power plants.
3. Sulfur dioxide levels could decrease further if improved pollution control devices are used.

INFORMATION SHEET

C. Carbon monoxide (CO)

1. Carbon monoxide levels decreased 32%.

2. Decrease in atmospheric carbon monoxide is due to emission control devices on motor vehicles.

D. Ozone (O_3)

1. Ozone levels decreased 13%.

2. Decrease in ozone is due to emission control devices on automobiles and improved emission control of electric power generators and industries.

3. Atmospheric ozone should continue to decline as control technology is improved.

(NOTE: It should be understood that ozone is a pollutant in the air we breathe, but the ozone shield high above the earth protects us from harmful radiation.)

E. Nitrogen dioxide (NO_2)

1. Nitrogen dioxide levels decreased 14%.

2. A decrease in nitrogen dioxide is a result of emission control devices on motor vehicles.

3. As improved emission control devices are perfected, nitrogen dioxide should continue to decrease; however, increases in the volume of traffic will offset reductions.

F. Lead (Pb)

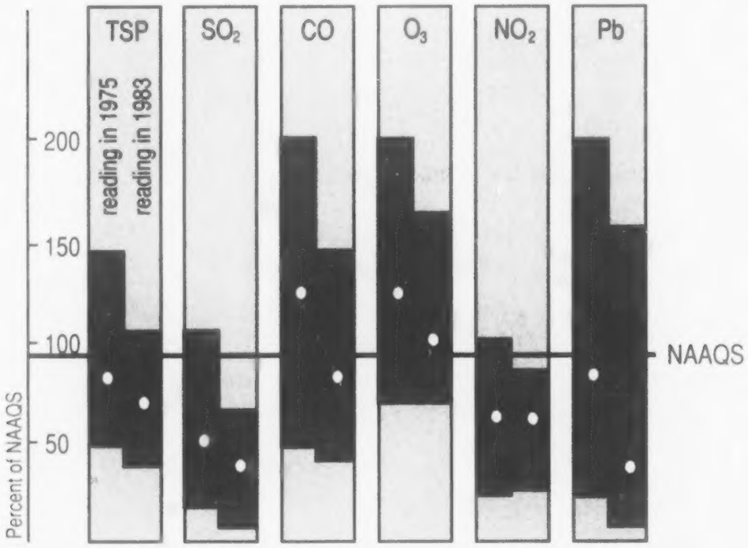
1. Lead in the atmosphere decreased 87%.

2. The decrease in atmospheric lead is primarily due to removing lead from gasoline.

3. Atmospheric lead is expected to decline further as less leaded gasoline is produced.

INFORMATION SHEET

Some Air Quality Trends



TSP = Total Suspended Particulates
SO_2 = Sulfur Dioxide
CO_2 = Carbon Monoxide
O_3 = Ozone
NO_2 = Nitrogen Dioxide
Pb = Lead
NAAQS = National Ambient Air Quality Standards

Courtesy of U.S. Environmental Protection Agency

XI. Global considerations in air resource management

A. Air pollutants generated in one country may affect neighboring countries or the world.

1. Sulfur dioxide emissions from coal power plants in the United States have caused acid rain in Canada.

2. Burning of rain forests in South America may contribute to the greenhouse effect, causing world climate change.

3. Synthetic chemicals from global industries may deplete the ozone shield causing serious health problems worldwide.

B. International cooperation will be needed to solve global air pollution problems.

C. International organizations such as the United Nations and the World Health Organization must develop global strategies to deal with air pollution.

D. If tomorrow's air is to be cleaner, today's activities must include consideration of air quality.

INFORMATION SHEET

XIII. Careers in air resource management

A. Meteorology

B. Environmental science

C. Air quality management

D. Physics

E. Air quality engineering

F. Physical, chemical, and engineering technicians

(NOTE: Salaries of individual careers will depend on level of education and years of experience.)

AIR RESOURCE MANAGEMENT
UNIT IV

ASSIGNMENT SHEET #1 — LOCATE SOURCES OF AIR POLLUTION IN YOUR AREA

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Report is neat and completed on time	______
Survey is thorough	______
Findings are accurate	______

Directions: Survey your local area for sources of outdoor air pollution. Note if any pollution devices are in use. Complete the chart below, and be prepared to discuss your findings in class.

Pollution Source	Location	Is pollution obvious?	Are pollution control devices being used? Describe.

AIR RESOURCE MANAGEMENT
UNIT IV

ASSIGNMENT SHEET #2 — WRITE A REPORT ON A GLOBAL ENVIRONMENTAL PROBLEM RELATED TO AIR RESOURCE MANAGEMENT

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Report is neat and completed on time	______
All parts of paper are included	______
Report is informative	______
Problem is well-defined	______
Solutions are correct	______
Future outlook is logical	______

Directions:

1. Select one of the following subjects for your report: Greenhouse effect, ozone shield, acid rain, smog.
2. Gather all the information you can find on your chosen subject.
3. Read the material and summarize your report.
4. Write a 2-3 page report including the following:
    a. Title page — Subject title, your name, class, date
    b. Body of paper to include
        1) Problem
        2) Causes of problem
        3) Solutions to the problem
        4) Future outlook
    c. Bibliography — Sources of information for report

AIR RESOURCE MANAGEMENT
UNIT IV

ASSIGNMENT SHEET #3 — COLLECT AND REPORT RESULTS FROM AIR MONITORING EQUIPMENT

NAME ______________________________ SCORE __________

(NOTE: This assignment can only be completed if state health department equipment is available and a technician is available to demonstrate its use.)

EVALUATION CRITERIA

Criteria	Rating
Report of procedure and tests is complete.	______
Tests are interpreted correctly.	______

Directions:

1. Listen to demonstration of equipment.
2. What are the names of the equipment being used? ______________________________
____
3. What tests can the equipment perform? ______________________________
____
4. Summarize the operational procedure. ______________________________
____
5. Report results of tests. ______________________________
____
6. Interpret results of test. ______________________________
____
____
____

AIR RESOURCE MANAGEMENT
UNIT IV

TEST

NAME ______________________________ SCORE __________

1. Match the terms on the right with the correct definitions.

______a. The mass of air surrounding the earth held by the force of gravity

______b. A mixture of invisible, odorless, tasteless gases that surround the earth

______c. Compounds composed of chemicals containing carbon

______d. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose

______e. An air pollution control device that uses a liquid spray to remove pollutants from a gas stream; also lowers the temperature of the emission

______f. A scale which represents alkalinity or acidity

______g. The level of pollutants in the outside air that by law cannot be exceeded during a specified time in a specified geographical area

______h. Abnormally high concentrations of air pollutants

______i. Lack of wind in an air mass

______j. Any unconfined portion of the atmosphere; the outside air

______k. Pollutant discharged into the air

1. Air
2. Air pollution episode
3. Ambient air
4. Atmosphere
5. Emission
6. National ambient air quality standards
7. Organic compounds
8. pH
9. Polar ice caps
10. Pollutant
11. Pollution
12. Population density
13. Respiratory system
14. Scrubber
15. Stagnation

2. State the three major components of air and give the percent composition of each.

Component	Percent
a. ____________________	________
b. ____________________	________
c. ____________________	________

TEST

3. Complete the following chart of air pollutants and health hazards associated with each.

	Air Pollutants	Health Hazard
a.	____ 1) Finely divided solid or liquid particles in the air or in an emission such as dust, smoke, and fumes. 2) Caused by ____ ____	Contributes to eye and throat irritation, bronchitis, lung damage, and impaired visibility
b.	Ozone 1) A pungent, colorless, toxic gas 2) Produced when sunlight hits air pollutants such as volatile organic compounds and nitrogen oxides from fossil fuel combustion	Causes ____ ____ ____ ____
c.	____ 1) A colorless, odorless, highly toxic gas. Can be deadly in small quantities if breathed over a certain period of time. 2) Is produced by incomplete fossil fuel combustion, primarily in motor vehicles	Impairs ability of blood to carry oxygen; affects heart, lung, and nervous systems
d.	____ 1) Heavy, pungent, colorless gas 2) Formed primarily through the burning of coal, fuel oils, and wood 3) Major contributor to acid rain	Respiratory tract problems; permanent damage to lung tissue

TEST

	Air Pollutants	Health Hazards
e.	Nitrogen dioxide 1) An invisible gas produced when oxygen in the air combines with nitric oxide that is produced by fossil fuel combustion, primarily in motor vehicles 2) Major contributor to smog and acid rain	Causes ______________________ ______________________ ______________________
f.	Lead (Airborne) 1) Exists in particles small enough to be carried by air currents 2) Generated primarily by automobiles using leaded gasoline	Causes ______________________ ______________________ ______________________

4. Complete statements concerning the environmental effects of air pollution by selecting the correct multiple-choice answer.

_____a. The greenhouse effect

1) Is caused by the depletion of the ozone shield
2) Is caused by smog
3) Is caused by carbon dioxide trapping heat
4) Does not occur in winter

_____b. Global warming

1) Would benefit everyone
2) Would cause sea levels to decrease due to evaporation
3) Would not affect the natural ecosystem
4) Would cause many agricultural areas to become nonproductive

_____c. The greenhouse effect is caused by

1) Too much carbon dioxide in the atmosphere
2) Burning of fossil fuels
3) Burning of rain forests
4) All of the above

TEST

______d. A solution to the problem of greenhouse effect is to

1) Cut down trees which produce carbon dioxide
2) Burn more coal and oil
3) Move to the country
4) None of the above

______e. Acid rain

1) Begins with the emission of sulfur dioxide and nitrogen dioxide
2) Is caused by ozone in the atmosphere
3) Is beneficial to streams and lakes
4) Can be eliminated by reducing lead in the atmosphere

______f. Acid rain

1) Increases fish populations
2) Improves forests by killing pests
3) Improves agricultural practices
4) None of the above

______g. Acid rain can be reduced by

1) Burning less coal
2) Reducing sulfur dioxide in automobile exhaust
3) Converting to cleaner fuels such as nuclear, solar, wind
4) All of the above

______h. Acid rain

1) Occurs only during the spring rains
2) Leaches metals from the soils and affects fish and aquatic plants
3) Is responsible for increased crop production
4) Kills harmful insects

______i. The ozone shield is a layer of ozone in the stratosphere

1) 6-30 miles above the earth
2) 30-100 miles above the earth
3) 1-2 miles above the earth
4) None of the above

______j. The depletion of the ozone shield is due to

1) Acid rain
2) Attack by chlorofluorocarbons
3) Increase in particulates in the atmosphere
4) Global warming

TEST

______k. If the ozone layer is destroyed,

1) Carbon dioxide levels would be reduced
2) The price of ozone would increase
3) Dangerous ultraviolet light will increase in intensity
4) Another one could be built but it would be expensive

______l. Chlorofluorocarbons (CFCs)

1) Are carbon compounds which preserve ozone destruction
2) Are manufactured and released to improve the air environment
3) Are compounds consisting of chlorine, fluorine, and carbon
4) Are good for the ozone layer

______m. Reduction of the ozone layer

1) Will cause an increase in skin cancer
2) Will increase U.V. radiation striking the earth
3) Will decrease crop yields
4) All of the above

______n. Smog is generally found

1) In rural areas
2) Downwind of feed lots
3) In densely populated areas
4) In unpopulated areas

______o. Smog is caused by

1) Automobile exhaust
2) High winds
3) Chlorofluorocarbons
4) Sulfuric acid

5. Select true statements concerning indoor air pollution by placing a T or F next to the true or false statements.

______a. Indoor air quality is frequently worse than outdoor.

______b. Most people spend most of their time indoors.

______c. New homes built to conserve energy usually do not have pollution problems.

______d. Eye, ear, nose, and throat problems may be caused by indoor air pollution.

______e. Indoor air pollution health problems are minor.

TEST

6. Match the indoor air pollutants on the right with the correct descriptions.

______a. Found in furniture, foam insulation, and pressed wood products

______b. Fibers are extremely small and become airborne when separated from parent material; can be inhaled or ingested; known to cause cancer

______c. Include pollen, mold, fungi, and viruses which can be brought indoors through heating and air conditioning systems and then multiply inside

______d. Contains heavy metals, particulates, and products of incomplete burning; causes 50-5,000 deaths per year

______e. Enters building through foundation cracks or seams; causes 5,000-20,000 deaths per year

1. Asbestos
2. Biological pollutants
3. Environmental tobacco smoke
4. Formaldehyde
5. Pesticides
6. Radon

7. Select true statements concerning air quality regulations by placing a T or F next to the true or false statements.

______a. Air quality regulations only affect big industries.

______b. Regulations have helped to improve air quality in the U.S.

______c. Air quality standards are only enforced by the federal government.

______d. Automobiles are exempt from air quality standards.

______e. Air quality standards do not exist in some states.

8. Name four methods of controlling motor vehicle emissions.

a. ____

b. ____

c. ____

d. ____

TEST

9. List three methods of controlling air pollution from industry and electrical power generating plants.

a. ______________________________

b. ______________________________

c. ______________________________

10. Complete the following statements concerning the progress made from 1976 to 1986 in controlling air pollution by circling the correct words.

a. Lead in the atmosphere has decreased (55%, 87%).

b. Atmospheric lead is expected to (increase, decrease) in the future.

c. Sulfur dioxide levels have decreased (37%, 87%).

d. Decrease in sulfur dioxide is primarily due to pollution control devices installed on (automobiles, coal-fired power plants).

e. Carbon monoxide levels have (increased, decreased) 32%.

11. Discuss global considerations in air resource management.

____

____

____

____

____

12. List three careers in air resource management.

a. ______________________________

b. ______________________________

c. ______________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Locate sources of air pollution in your area. (Assignment Sheet #1)

14. Write a report on a global environmental problem related to air resource management. (Assignment Sheet #2)

15. Collect and report results from air monitoring equipment. (Assignment Sheet #3)

AIR RESOURCE MANAGEMENT
UNIT IV

ANSWERS TO TEST

1. a. 4
   b. 1
   c. 7
   d. 10
   e. 14
   f. 8
   g. 6
   h. 2
   i. 15
   j. 3
   k. 5

2. a. Nitrogen 78%
   b. Oxygen 21%
   c. Argon 0.9%

3. a. Particulate matter
   2) Any of the following: Steel mills, power plants, cement plants, grain elevators, dirt roads, fireplaces, agricultural burning, or forest fires

   b. Any of the following: Serious respiratory problems such as breathing difficulties, asthma, reduced lung function, eye irritation, nasal congestion, or reduced resistance to infection

   c. Carbon monoxide

   d. Sulfur dioxide

   e. Respiratory illness or lung damage

   f. Brain damage or serious physical and mental impairment, especially in children

4. a. 3
   b. 4
   c. 4
   d. 4
   e. 1
   f. 4
   g. 4
   h. 2
   i. 1
   j. 2
   k. 3
   l. 3
   m. 4
   n. 3
   o. 1

5. a. T
   b. T
   c. F
   d. T
   e. F

6. a. 4
   b. 1
   c. 2
   d. 3
   e. 6

ANSWERS TO TEST

7. a. F
   b. T
   c. F
   d. F
   e. F

8. Any four of the following:

   a. Reduce the escape of hydrocarbons from carburetors and fuel system.
   b. Keep engines tuned.
   c. Maintain emission control systems and catalytic converters.
   d. Use lead-free gasoline.
   e. Reduce sulfur compounds during refining of diesel fuel.
   f. Use ethanol (grain alcohol) as a fuel.
   g. Use methanol (wood alcohol) as a fuel.

9. Any three of the following:

   a. Install equipment (scrubbers) to remove air contaminants from stack exhaust.
   b. Remove pollutants from fuel source such as sulfur from coal.
   c. Use technologies which reduce contaminants in exhaust emissions.
   d. Use coal with low sulfur content.
   e. Convert operations to fuels which produce less air pollutants such as solar, wind, and nuclear.

10. a. 87%
    b. Decrease
    c. 37%
    d. Coal-fired power plants
    e. Decreased

11. Discussions should include that air pollution affects all countries. Pollutants generated in one country will cause problems in another country and worldwide. International cooperation is needed to control air pollution. Students may give specific examples.

12. Any three of the following:

    a. Meteorology
    b. Environmental science
    c. Air quality management
    d. Physics
    e. Air quality engineering
    f. Physical, chemical, and engineering technicians

13-15. Evaluated to the satisfaction of the instructor.

WILDLIFE MANAGEMENT
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to describe food chains and webs, distinguish between major wildlife species, and list fish and wildlife in the area. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to wildlife management with the correct definitions.
2. Complete statements concerning a food chain.
3. Show interconnections in a food web.
4. Complete statements concerning the predator/prey relationship.
5. Complete statements concerning the history of wildlife.
6. Match federal legislation concerning wildlife with the correct definitions.
7. Distinguish between the types of birds.
8. Distinguish between small mammals and large mammals.
9. List major fish species.
10. List U.S. endangered species.
11. List dangers to wildlife populations.
12. List agricultural practices that support wildlife.
13. Select from a list the wildlife activities that cause damage to agriculture.
14. List ways to control wildlife damage problems.
15. Select true statements concerning public wildlife and private lands.
16. Match the types of private wildlife production areas with the correct definitions.
17. List government agencies involved in wildlife management.
18. List major private wildlife organizations.
19. List careers in wildlife management.
20. Discuss effects on a food chain when parts are removed. (Assignment Sheet #1)

SPECIFIC OBJECTIVES

21. Create a food web. (Assignment Sheet #2)

22. List fish and wildlife in your area. (Assignment Sheet #3)

23. Identify wildlife you see in a certain time span. (Assignment Sheet #4)

24. Compile a profile of a wildlife species. (Assignment Sheet #5)

WILDLIFE MANAGEMENT
UNIT V

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These are included in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Food Chains — Objective 2

TM 2 — Biotic Pyramid — Objective 2

TM 3 — Food Web — Objective 3

TM 4 — Agricultural Practices That Support Wildlife — Objective 12

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Obtain information on local private wildlife organizations.
2. Arrange for hunter safety and sportsmanship programs to be conducted for interested students and community members.
3. Invite a game warden as a guest speaker to discuss job duties and state laws affecting wildlife.
4. Take a tour of a local fish hatchery or other aquaculture business.
5. Tour a game production area.
6. Obtain information about endangered species in your state.
7. Discuss the cause and effect of pollution on endangered species.
8. Make a scrapbook showing pictures of local species of wildlife.
9. Discuss how different wildlife species relate to each other.

SUGGESTED ACTIVITIES

10. Demonstrate a food web.
    a. Have students form their chairs in a circle.
    b. Give each student a poster with a name or picture of an organism. (Hawk, mouse, grass, etc.)
    c. Give each student a ball of yarn or string.
    d. Have students connect their strings to form a food web.

       Examples: Lion to rabbit, owl to mouse, elk to grass and shrubs, etc.
    e. The result will be a food web.
11. Students may wish to have a special project on wildlife management to qualify for an FFA Wildlife Management Proficiency Award. Refer to the FFA *Agricultural Proficiency Award Handbook* for more details.
12. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Camp, William G. *Managing Our Natural Resources.* Albany, NY: Delmar Publishers Inc., 1988.

B. Dietrich, Irvine. *Conservation of Natural Resources.* St. Paul, MN: Webb Publishing Co., 1962.

C. *Wildlife Identification Pocket Guide.* Seattle, WA: Outdoor Empire Publishing, Inc., 1986.

D. Teague, Richard D. *Wildlife Conservation*, 2nd ed. Washington, DC: The Wildlife Society, 1979.

E. Cadieux, Charles. *These Are The Endangered.* Washington, DC: The Stone Wall Press, Inc., 1981.

F. *Kansas Aquatics Resource Education.* Seattle, WA:, 1986.

G. Kircher, Harry B. *Our Natural Resources and Their Conservation*, 6th ed. Danville, IL: The Interstate Printers & Publishers, Inc., 1988.

RESOURCES USED IN DEVELOPING THIS UNIT

H. *Outdoor Classrooms on School Sites.* USDA — Soil Conservation Service, 1980.

I. *Managing Forested Lands for Wildlife.* USDA, U.S. Forest Service, Rocky Mountain Region. Published by Colorado Division of Wildlife, 1984.

SUGGESTED SUPPLEMENTAL RESOURCES

A. *Wildlife Identification Pocket Guide.* Seattle, WA: Outdoor Empire Publishing, 1986.

B. Hines, Bob. *Ducks At A Distance.* Seattle, WA: Outdoor Empire Publishing, Inc., 1978.

C. Computer software

1. *Agri-Quiz: Wildlife Conservation.* Contains approximately 300 T-F and multiple-choice questions for contest preparation and classroom use. For IBM-PC or Apple II family.

2. *Endangered Species.* For Apple II series.

Software programs listed in C1 and 2 are available from:

Instructional Materials Service
Cornell University
24 Roberts Hall
Ithaca, NY 14853-5901
607-255-3002

D. Films, filmstrips, and videotapes

1. *Year of the Eagle.* 27 min. ½" and ¾" video. Traces the life cycle and discusses problems contributing to its drastic reduction in population. Available from:

Centre Productions, Inc.
Distributed by Barr Films
12801 Schabarum Avenue
P.O. Box 7878
Irwindale, CA 91706-7878
818-338-7878

2. *The Last Chance.* 1980. 28 min. 16mm or video. Produced by Friends of the National Zoo. Discusses endangered species and career information about studying and working with them. Available from:

Bull Frog Films, Inc.
Oley, PA 19547
800-543-FROG

SUGGESTED SUPPLEMENTAL RESOURCES

3. *Managing Wildlife: Is It For You?* Sound filmstrips exploring careers in wildlife management. Also shows how to set up a wildlife project. Available from:

   Vocational Education Productions
   California Polytechnic State University
   San Luis Obispo, CA 93407
   800-235-4146

4. *In Celebration of America's Wildlife.* 1988. 57 min. Video. Discusses efforts in the last 50 years to restore wildlife populations, especially those aided through the Pittman-Robertson Program. Many wildlife populations included. This video was produced by the U.S. Fish and Wildlife Service and is available through many state or county cooperative extension offices. It is also available from:

   Commonwealth Films, Inc.
   1500 Brook Road
   Richmond, VA 23220
   804-649-8611

5. *What is Ecology?*, 2nd edition. 21 min. 16mm or video. Discusses basic ecological concepts such as food chains, food webs, biotic pyramid, predators, prey, etc. Available from:

   Britannica Films and Videos
   425 N. Michigan Avenue
   Chicago, IL 60611
   800-558-6968

E. *Bird and Mammal Wall Charts.* Two sets of full-color, 20" × 30" wall charts (4 per set) showing various birds and mammals.

F. *Wildlife Notes on 33 Mammals and Birds.* Pamphlets on 33 common wildlife species.

E and F are available from:

Instructional Materials Service
Cornell University
24 Roberts Hall
Ithaca, NY 14853-5901
607-255-3002

G. *Project WILD Activity Guide (Secondary).* Developed by the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council. To obtain this activity guide, you must attend a Project WILD workshop. Contact your state wildlife, conservation, or natural resource department for more information about these workshops.

Food Chains

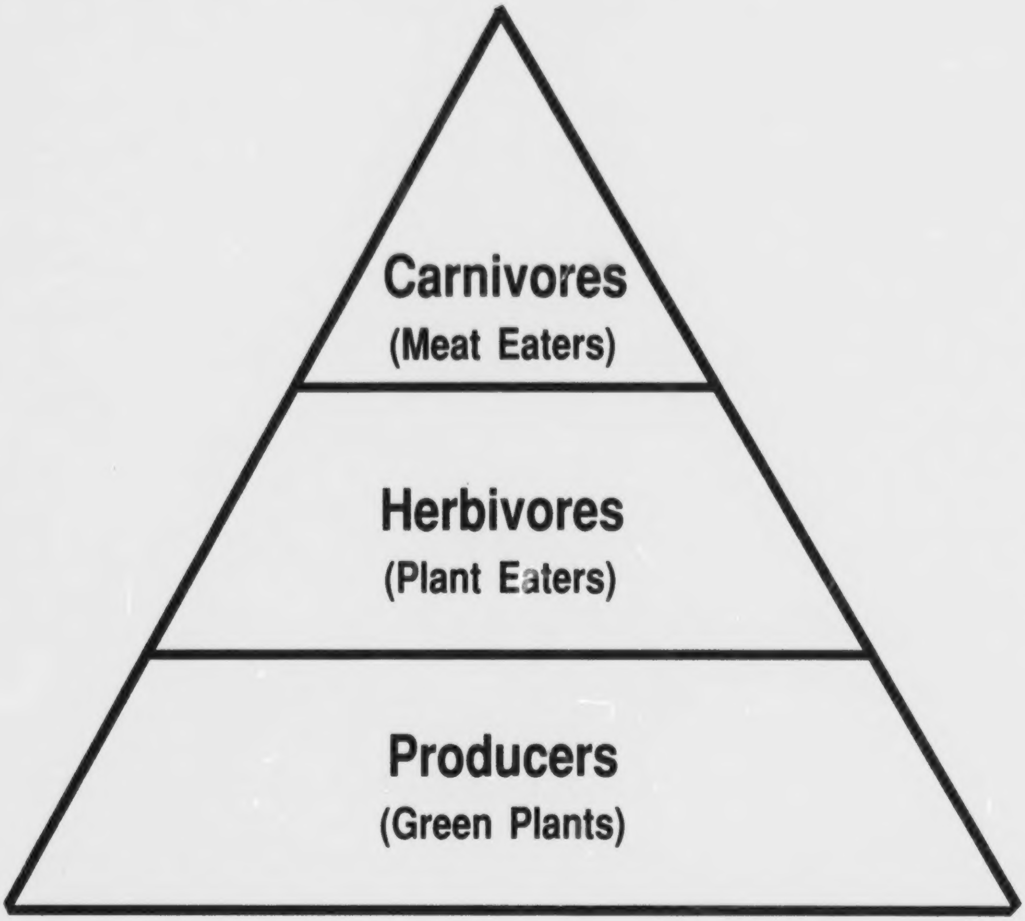
Grass → Grasshopper → Frog

Snake → Hawk

Grass, Tree Leaves → Deer → Mountain Lion

Grass → Mouse → Owl → Hawk

Biotic Pyramid



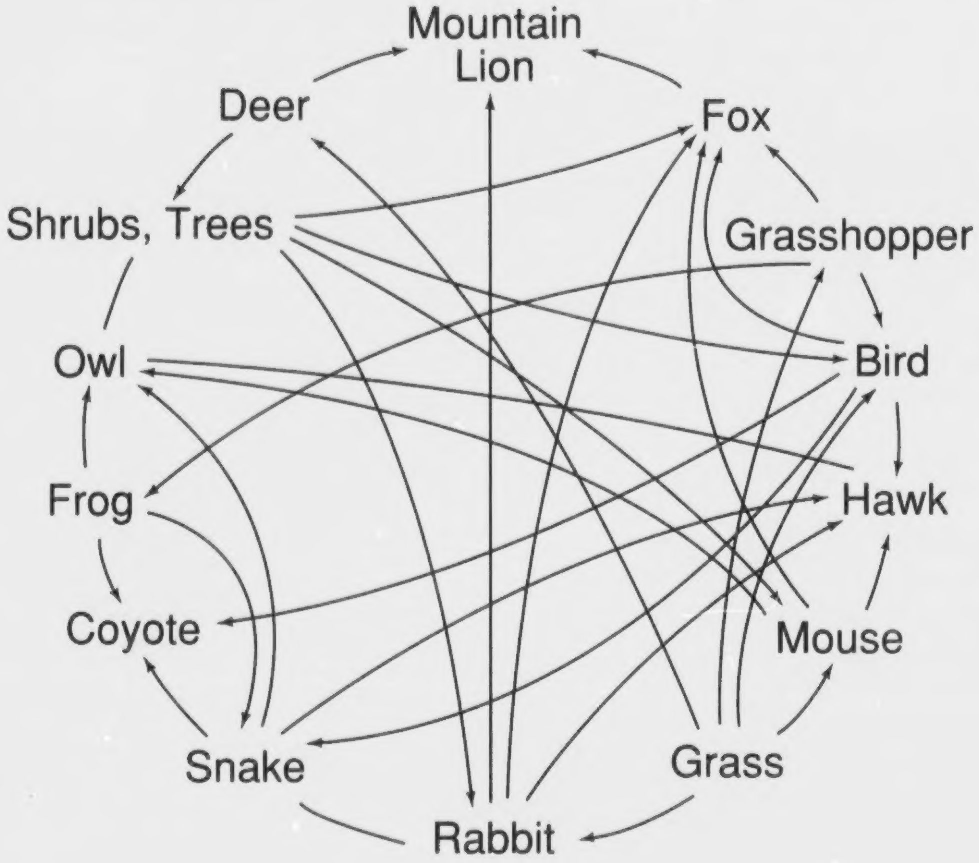
Carnivores
(Meat Eaters)

Herbivores
(Plant Eaters)

Producers
(Green Plants)

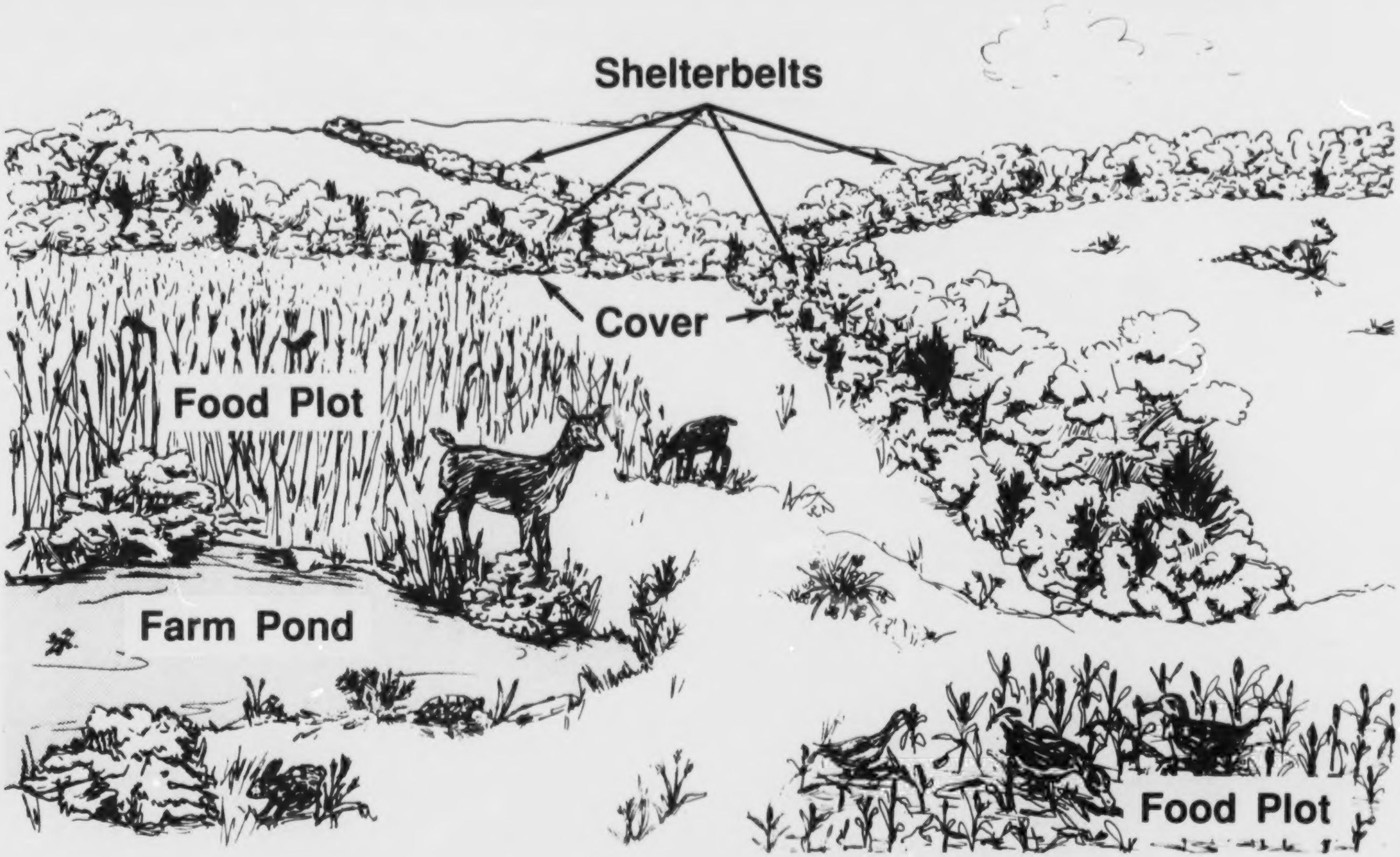
(NOTE: A pyramid shape is often used to show the food chain concept because a great many more producers are required to support herbivores, and more herbivores are needed to support carnivores. Omnivores can occupy both the middle and top levels in the pyramid depending on their food source at the time.)

Food Web


Mountain Lion
Deer
Fox
Shrubs, Trees
Grasshopper
Owl
Bird
Frog
Hawk
Coyote
Mouse
Snake
Grass
Rabbit

(NOTE: Arrows point to the consumer.)

Agricultural Practices That Support Wildlife


Shelterbelts
Cover
Food Plot
Farm Pond
Food Plot

TM 4

NR-217

WILDLIFE MANAGEMENT
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Bag limit — The legal number of game animals that can be taken
B. Carnivores — Animals that eat meat (other animals)
C. Cover — Vegetation or other material providing protection to an animal
D. Ecosystem — The interacting system of biological community and its nonliving environment
E. Edge — The transitional zone where one cover type ends and another begins
F. Endangered species — Species that is in danger of becoming extinct through all or part of its range
G. Exotic — Species not native to an area
H. Extinct species — Species that no longer exists
I. Food chain — An arrangement of predator-prey relationship in an ecosystem
J. Food plot — Area planted to maintain wildlife food supply
K. Food web — The interconnected food chains within an ecosystem
L. Game animal — Animal hunted by humans for its fur, flesh, or trophy value
M. Habitat — The area where an animal or plant naturally lives and grows
N. Herbivores — Animals that eat plants
O. Migrate — To move from one region or climate to another for feeding or breeding
P. Nocturnal — Active at night
Q. Omnivores — Animals that eat both animals and plants
R. Population density — The number of animals in a defined area
S. Predators — Animals that hunt, kill, and consume other animals
T. Prey — An animal taken as food by a predator
U. Raptor — A bird of prey
V. Refuge, reserve, or wilderness area — An area of land set aside for the protection of wildlife

INFORMATION SHEET

W. Season — Time set aside for legal hunting or fishing

X. Species — A group of organisms that resemble each other closely and that interbreed freely

Y. Surplus — Amount over and above what is needed

Z. Upland — The higher parts of a region

AA. Wetlands — Swamps or marshes, especially as areas used by wildlife

BB. Wildlife — Mammals, birds, and fish not domesticated

CC. Wildlife biology — The manipulation of land, water, plants, and animals to produce animals for recreational use by humans

DD. Wildlife management — The art of making land produce sustained annual crops of wild game

II. Food chain

A. A food chain is the connecting link between various organisms as they eat to survive and multiply.

B. On the first level of the food chain are the "producers".

Examples: Green plants — Grass, shrubs, trees

C. On the second level of the food chain are the "herbivores" which consume plant material to survive.

Examples: Grasshoppers, mice, rabbits, deer, birds

D. On the third level of the food chain are the "carnivores" which consume herbivores to survive.

Examples: Coyote, hawk, mountain lion, owl

E. Some organisms consume food at more than one level. They are called "omnivores".

Examples: Bears eat berries (from plants) and fish; birds eat plant nuts or fruit as well as worms and insects

F. Examples of straight food chains would include:

Grass, shrubs, tree leaves → deer → mountain lion

Grass → grasshopper → frog → snake → hawk

Grass → mouse → owl

INFORMATION SHEET

III. Food web

A. A food web shows the interconnecting food chains in an ecosystem.

B. Each organisms is generally a part of more than one food chain.

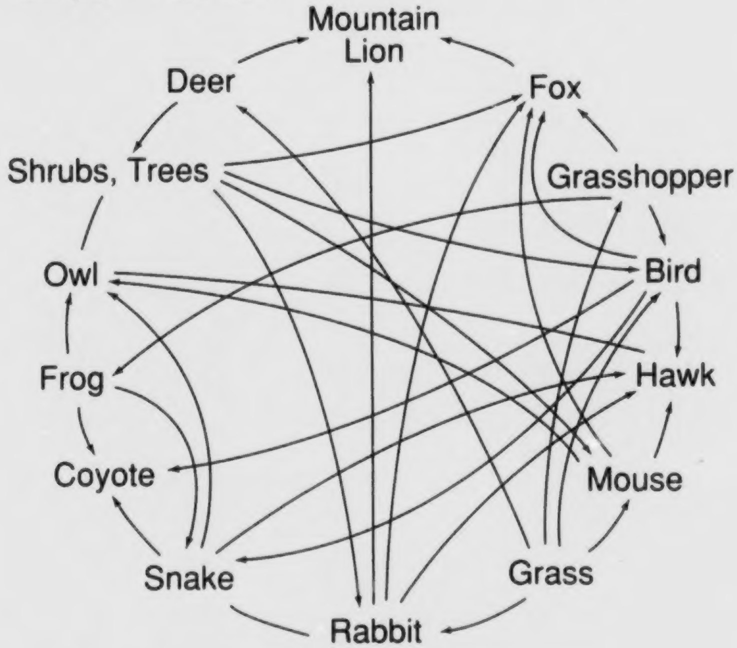
C. Not all food chains travel in a straight manner.

Example: An owl may consume a frog which has consumed a cricket. The owl may also consume a rabbit which has consumed grass.

D. Members of a food web are dependent on each other for survival. Any change in the ecosystem affects all members of that food web.

E. In a diagram which connects various organism according to their food preference, the crossing lines form a food web.

Example: Food web


Mountain Lion
Deer
Fox
Shrubs, Trees
Grasshopper
Owl
Bird
Frog
Hawk
Coyote
Mouse
Snake
Grass
Rabbit

(NOTE: Arrows point to the consumer.)

IV. Predator/prey relationships

A. Until about 50 years ago, predators were killed at random.

B. Predators are not usually destructive, but they can be.

INFORMATION SHEET

C. Predators can be beneficial.

  1. Predators can control the population of a prey species.
  2. Predators feed on pest animals.
  3. Control by predators can keep the prey species healthy.
  4. Predators maintain populations by killing weak individuals of the prey species.

D. Humans are the only predators capable of exterminating a prey species.

V. **Wildlife history in the United States**

A. Early America became established in the world fur trade business by overharvesting wildlife.

B. Many wildlife were killed because they appeared to be hostile.

C. Market hunting caused the decline of some species.

D. Rural people killed wildlife for food.

E. The management of wildlife was handled by the individual states.

F. Rhode Island was the first state to establish a closed hunting season.

G. The first bag limit was initiated in 1878 in Iowa.

H. In 1906, man killed the predators of Kaibab deer, causing the deer population to increase until they destroyed their habitat and died of starvation.

I. The last known passenger pigeon died in 1914.

J. The Carolina parakeet became extinct because their feathers were used for hats.

K. A fire caused the death of the last protected heath hens.

L. Bounties were once placed on the bald eagles because they were thought to have fed on salmon.

M. Fur collectors used airplanes to hunt and kill polar bears.

N. As more and more wildlife species have been threatened, the federal government has stepped in to protect fish and wildlife threatened with extinction.

O. Presently, loss of habitat is the main concern affecting wildlife populations.

INFORMATION SHEET

VI. Federal legislation concerning wildlife

A. Lacey Act — Brought the federal government into the business of wildlife law enforcement.

B. Fish and Wildlife Conservation Act — Called for identification of fish and wildlife not taken for sport or commercial purposes.

C. Migratory Bird Conservation Act (1934) or "Duck Stamp" Program — Funded by a special annual fee paid by active hunters and non-hunting friends of wild waterfowl to acquire refuges and to lease wetlands for the primary benefit of migratory birds.

D. Federal Aid in Wildlife Restoration Act (1937) or Pittman-Robertson Act — Provided funding for wildlife management by placing an excise tax on firearms and ammunition.

E. Federal Aid in Sport Fish Restoration Act (1950) or Dingell-Johnson Act — Provided funding for fish management by taxing fishing and boating equipment.

(NOTE: As amendments or refunding are added to the original bills, the names sometimes change, but the above names are still commonly used.)

F. Endangered Species Act (1973) — Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service.

G. North American Waterfowl Management Plan (NAWMP) (1986) — Partnership between U.S. and Canada to protect the 37 species of North American waterfowl (ducks, geese, swans) shared by both countries.

VII. Major types of birds

A. Upland nonmigratory birds

- Grouse
- Quail
- Pheasant
- Wild turkey
- Partridge

B. Wetland migratory birds

1. Ducks
    - Mallard
    - Teal
    - Wigeon
    - Redhead
    - Scaup
    - Ruddy

INFORMATION SHEET

- Shoveler
- Wood
- Merganser
- Canvasback

2. Geese
    - Canada goose
    - Snow goose
    - White fronted goose
3. Cranes
    - Sandhill crane
    - Whooping crane
    - Blue heron

C. Raptors

- Eagle
- Falcon
- Osprey
- Hawk
- Owl

VIII. Common mammals

A. Large mammals

- Elk (Wapiti)
- Deer
- Sheep
- Bison
- Bighorn sheep
- Mountain goat
- Moose
- Pronghorn antelope
- Bear

B. Small mammals

- Lynx
- Badger
- Wolverine
- Mink
- Fox
- Coyote

- Marmot
- Squirrel
- Prairie dog
- Beaver
- Muskrat
- Opossum
- Raccoon
- Weasel
- Porcupine
- Skunk
- Chipmunk
- Woodchuck
- Hare
- Rabbit
- Bobcat

IX. Major fish species

- Bullhead
- Catfish
- Crappie
- Trout
- Bass
- Bluegill
- Pike
- Perch

X. U.S. endangered species

(NOTE: There are approximately 124 birds, 133 mammals, and 25 fish on the endangered species list. There have been 9 mammals, 31 birds, and 6 fish become extinct in the United States this century. Each state also has a list of species endangered in that state. These lists vary so all of the following species are not necessarily endangered in every state.)

A. Endangered mammals

1. Bat (ozark, gray)
2. Grizzly bear
3. Wolf (red, grey)
4. Black-footed ferret
5. Swift fox
6. Jaguar
7. Jaguarundi

INFORMATION SHEET

B. Endangered birds
  1. Whooping crane
  2. Bald eagle
  3. Woodpecker (ivory-billed, red-cockaded)
  4. Eskimo curlew
  5. Interior least tern
  6. Peregrine falcon

C. Endangered fish
  1. Bonytail chub
  2. Humpback chub
  3. Leopard darter
  4. Gambusia (big bend, clear creek, pecos)
  5. Comanche pupfish
  6. Colorado River squawfish
  7. Greenback trout
  8. Central mudminnow
  9. Pearl dace
  10. Banded killfish

XI. Dangers to wildlife populations

A. Illegal hunting
B. Predators
C. Starvation
D. Droughts
E. Storms
F. Diseases
G. Parasites
H. Fires

INFORMATION SHEET

I. Accidents

J. Human activities including pollution

K. Loss of habitats

XII. Agricultural practices that support wildlife

A. Farm around the hill (contour) to control sediment that might enter and ruin ponds, lakes, and streams.

B. Leave fence rows undisturbed to provide cover so wildlife can travel to other areas.

C. Provide farm ponds and tanks for wildlife drinking water.

D. Use windbreaks and shelterbelts to provide habitat for wildlife.

E. Seed legumes and grasses to provide food and cover for wildlife.

F. Leave brush and dead (den) trees to provide nesting cover for wildlife.

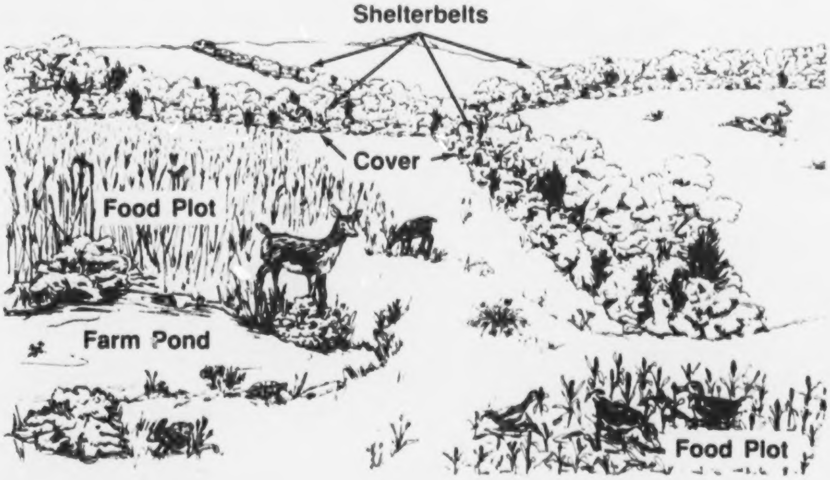
G. Prevent overgrazing on grassland to protect escape cover, nesting cover, and food for wildlife.

H. Leave crop residue on the land to provide food for wildlife.

I. Provide food plot areas to keep wildlife away from crops.

J. Maintain existing wetlands to assure future wildlife habitat.

Example: Agricultural practices that support wildlife



INFORMATION SHEET

XIII. Wildlife activities that may cause damage to agriculture

A. Carry diseases.

(NOTE: Diseases can be passed from wildlife to domestic animals and from domestic animals to wildlife.)

B. Prey on domestic livestock and poultry.

C. Feed on agricultural crops.

D. Compete for grass on grazing lands.

E. Feed on stored feed supplies.

F. Cause damage to trees.

G. Cause damage to buildings and equipment.

XIV. Ways to control wildlife damage problems

A. Reduce the number of destructive animals.

B. Provide fencing or other mechanical barriers.

C. Use frightening techniques.

D. Encourage adequate game harvest by hunters.

E. Adjust agricultural practices.

F. Establish feeding and resting areas on noncrop lands.

XV. Public wildlife and private land

A. Private lands can provide wildlife for recreation.

B. Landowners should be provided an incentive to support wildlife.

C. Many landowners prefer to see wildlife on their land.

D. Wildlife share with domestic animals the farm habitat including food, shelter, and space.

E. Most state and federal wildlife agency money is spent on public lands.

F. Many landowners receive compensation for good land management practices from the U.S. Department of Agriculture.

G. More than 80% of the game is harvested on private land.

INFORMATION SHEET

XVI. Types of private production areas

A. Cooperatives — Landowners open their land in exchange for protection against random trespassing

B. Preserves — Areas set aside exclusively for owners and members

C. Commercial wildlife enterprises — Provide "package hunts"

D. Exotic and native big game ranches — Provide a pay hunt

E. Farms — Raise and sell wildlife animals, birds, and fish

XVII. Government agencies involved in wildlife management

A. State wildlife, conservation, and natural resource departments

B. Fish and Wildlife Service

C. Forest Service

D. National Park Service

E. Soil Conservation Service

F. Corps of Engineers

G. Bureau of Reclamation

H. Bureau of Land Management

I. Environmental Protection Agency

XVIII. Major private wildlife organizations

A. Audubon Society

B. Izaak Walton League of America Inc.

C. National Wildlife Federation

D. Nature Conservancy

E. Wildlife Society

F. Sierra Club

G. Ducks Unlimited

H. Quail Unlimited

I. Pheasants Forever

INFORMATION SHEET

XIX. Careers in wildlife management

A. Fishery biologist

B. Wildlife biologist

C. Refuge manager

D. Special agent (law enforcement)

E. Technicians (biological, fish and wildlife)

F. Conservationist

G. Zoologist

WILDLIFE MANAGEMENT
UNIT V

ASSIGNMENT SHEET #1 — DISCUSS EFFECTS ON A FOOD CHAIN WHEN PARTS ARE REMOVED

NAME ______________________________ SCORE ______________

EVALUATION CRITERIA

Criteria	Rating
Neatness	______
Directions are followed	______
Discussions are complete	______
Discussions are accurate	______

Directions:

1. Use the following food chain consisting of five organisms:

   Grass → grasshopper → frog → snake → hawk.

2. Begin by removing the hawk from the chain.
3. Discuss the result or change in the ecological system.
4. Next replace the hawk in the chain and remove the snake.
5. Discuss the result or change in the ecological system.
6. Continue this process until all five organisms are individually removed. Discuss the results below.

WILDLIFE MANAGEMENT
UNIT V

ASSIGNMENT SHEET #2 — CREATE A FOOD WEB

NAME ________________________________ SCORE ______________

EVALUATION CRITERIA	
Criteria	Rating
Neatness	_____
Ten organisms are used	_____
Organisms are correctly identified	_____
Completeness/effort	_____

Directions:

1. Find pictures of ten organisms.
2. Cut pictures from magazines, newspapers, or wildlife brochures.
3. Identify each as producers, herbivores, carnivores, or omnivores.
4. Attach pictures to a plain background in a circle to form a food web.

WILDLIFE MANAGEMENT
UNIT V

ASSIGNMENT SHEET #3 — LIST FISH AND WILDLIFE IN YOUR AREA

NAME ______________________________ SCORE __________

EVALUATION CRITERIA	
Criteria	Rating
Information is correct	_____
Species are correctly classified	_____
Fifteen species are listed	_____
Assignment is neat and completed on time	_____

Directions: Make a list of fifteen local fish and wildlife species. Classify the wildlife by placing the proper symbol beside the species name.

U — Upland bird
W — Wetland bird
R — Raptor
L — Large mammal
S — Small mammal
F — Fish

NAME	SYMBOL
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	

WILDLIFE MANAGEMENT
UNIT V

ASSIGNMENT SHEET #4 — IDENTIFY WILDLIFE YOU SEE IN A CERTAIN TIME SPAN

NAME ______________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Information is correct	______
Directions were followed	______
Ten species are listed	______
Assignment is neat and completed on time	______

Directions: Choose an area inhabited by wildlife. Note that location below. Identify the wildlife species that you see there. Continue to observe until you identify at least ten species. Then note the time span that it took you to observe 10 species in that location.

Location ______________________ Time Span From __________ to __________

Wildlife Species Observed

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

WILDLIFE MANAGEMENT
UNIT V

ASSIGNMENT SHEET #5 — COMPILE A PROFILE OF A WILDLIFE SPECIES

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Information is correct	______
Directions were followed	______
Report is well planned	______
Report is interesting	______
Assignment is neat and completed on time	______

Directions: Compile a detailed profile about a specific wildlife species. Include the following information:

- Description of animal
- Habitat requirements (include feeding and cover requirements)
- Reproduction characteristics
- Role of animal in the environment
- Future
- Summary

The report may be given written or orally as determined by instructor.

WILDLIFE MANAGEMENT
UNIT V

TEST

NAME ____ SCORE __________

1. Match the terms on the right with the correct definitions.

______a. Animal hunted by humans for its fur, flesh, or trophy value

______b. Animals that eat plants

______c. Species not native to an area

______d. Vegetation or other material providing protection to an animal

______e. The interacting system of biological community and its nonliving environment

______f. A bird of prey

______g. Mammals, birds, and fish not domesticated

______h. Species that is in danger of becoming extinct through all or part of its range

______i. The transitional zone where one cover types ends and another begins

______j. An arrangement of predator-prey relationship in an ecosystem

______k. An area of land set aside for the protection of wildlife

______l. The area where an animal or plant naturally lives and grows

______m. Animals that eat meat

______n. Swamps or marshes, especially as areas used by wildlife

______o. The group of organisms that resemble each other closely and that interbreed freely

1. Bag limit
2. Carnivores
3. Cover
4. Ecosystem
5. Edge
6. Endangered species
7. Exotic
8. Extinct species
9. Food chain
10. Food plot
11. Food web
12. Game animal
13. Habitat
14. Herbivores
15. Migrate
16. Nocturnal
17. Omnivores
18. Population density
19. Predators
20. Prey
21. Raptor

TEST

______p. Active at night

______q. Species that no longer exists

______r. An arrangement of interconnected food chains within an ecosystem

______s. Time set aside for legal hunting or fishing

______t. The number of animals in a defined area

22. Refuge, reserve, or wilderness area
23. Season
24. Species
25. Wetlands
26. Wildlife

2. Complete the following statements concerning a food chain by filling in the blanks with the appropriate words. Select your answers from the following: carnivores, herbivores, producers, omnivores.

   a. On the first level of the food chain are the "__________________________."

   b. On the second level of the food chain are the "__________________________."

   c. On the third level of the food chain are the "__________________________."

   d. Some organisms consume food at more than one level. These are called "__________________________."

3. Show the interconnections that make a food web between the following components. Draw lines with arrows pointing to the consumer (from the food source).

Shrubs and Trees
(including nuts and fruit)

Mountain Lion **Hawk**

Robin **Deer**

Rabbit **Grasshopper**

Grass
(including seeds)

TEST

4. Complete the following statements concerning the predator/prey relationship by circling the correct words.
   a. Until about (10, 50) years ago, predators were killed at random.
   b. Predators (are, are not) usually destructive.
   c. Predators can control the (genetic makeup, population) of a prey species.
   d. Predators normally kill the (strong, weak) individuals of the prey species.
   e. Humans are the only predators capable of (threatening, exterminating) a prey species.

5. Complete the following statements concerning the history of wildlife by circling the correct answers.
   a. Early America became established in the world (food, fur) trade business by overharvesting wildlife.
   b. Many wildlife were killed because they appeared to be (hostile, unimportant).
   c. The management of wildlife was handled by the (federal, state) government(s).
   d. (California, Rhode Island) was the first state to establish a closed hunting season.
   e. The first bag limit was initiated in (1778, 1878) in Iowa.
   f. In 1906, man killed the (predators, prey) of the Kaibab deer, causing the deer population to increase until they destroyed their habitat and died of starvation.
   g. (Bounties, Fines) were once placed on the bald eagles because they were thought to have fed on salmon.
   h. Presently, loss of (water, habitat) is the main concern affecting wildlife populations.

6. Match the federal legislation on the right with the correct definitions.

______a. Brought the federal government into the business of wildlife law enforcement

______b. Provided funding for fish management by taxing fishing and boating equipment

______c. Called for identification of fish and wildlife not taken for sport or commercial purposes

1. Lacey Act
2. Fish and Wildlife Conservation Act
3. Federal Aid in Wildlife Restoration Act or Pittman-Robertson Act

TEST

______d. Gave authority for protecting rare and endangered species to the U.S. Fish and Wildlife Service

______e. Provided funding for wildlife management by placing an excise tax on firearms and ammunition

______f. Partnership between U.S. and Canada to protect 37 species of waterfowl shared by both countries

4. Federal Aid in Sport Fish Restoration Act or Dingell-Johnson Act

5. Endangered Species Act

6. Migratory Bird Conservation Act or "Duck Stamp" Program

7. North American Waterfowl Management Plan

7. Distinguish between the types of birds by placing the proper symbol beside the appropriate birds.

- U — Upland nonmigratory
- W — Wetland migratory
- R — Raptor

______a. Hawk

______b. Eagle

______c. Snow goose

______d. Teal duck

______e. Mallard duck

______f. Falcon

______g. Quail

______h. Whooping crane

______i. Pheasant

______j. Wild turkey

8. Distinguish between small mammals and large mammals by placing an "X" beside the large mammals.

______a. Bear

______b. Prairie dog

______c. Beaver

TEST

______d. Bighorn sheep

______e. Bison

______f. Elk

______g. Marmot

______h. Muskrat

______i. Moose

______j. Bobcat

______k. Rabbit

______l. Raccoon

9. List four major fish species.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

10. List eight endangered species.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

TEST

11. List five dangers to wildlife populations.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

12. List three agricultural practices that support wildlife.

a. ____________________

b. ____________________

c. ____________________

13. Select from the following list the wildlife activities that may cause damage to agriculture by placing an "X" beside the damaging activities.

______a. Carry diseases

______b. Prey on domestic livestock and poultry

______c. Provide recreation

______d. Feed on agricultural crops

______e. Compete for grass on grazing lands

______f. Provide for game hunts

______g. Feed on stored feed supplies

______h. Cause damage to trees

______i. Cause damage to buildings and equipment

______j. Provide food to hunters

14. List three ways to control wildlife damage problems.

a. ____________________

b. ____________________

c. ____________________

TEST

15. Select true statements concerning public wildlife and private lands by placing a "T" beside the true statements and an "F" next to the false statements.

______a. Many landowners prefer to see wildlife on their land.

______b. Wildlife share with domestic animals the farm habitat including food, shelter, and space.

______c. Most state and federal wildlife agency money is spent on private lands.

______d. Many landowners receive compensation for good land management practices from the Department of Land Management.

______e. About 20% of game wildlife is harvested on private land.

16. Match the types of private wildlife production areas on the right with the correct definitions.

______a. Raise and sell wildlife animals, birds, and fish

______b. Areas set aside exclusively for owners and members

______c. Provide "package hunts"

______d. Landowners open their land in exchange for protection against random trespassing

1. Cooperatives
2. Preserves
3. Commercial wildlife enterprises
4. Exotic and native big game ranches
5. Farms

17. List four government agencies involved in wildlife management.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

18. List three major private wildlife organizations.

a. ______________________________

b. ______________________________

c. ______________________________

TEST

19. List three careers in wildlife management.

a. ____________________

b. ____________________

c. ____________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

20. Discuss effects on a food chain when parts are removed. (Assignment Sheet #1)

21. Create a food web. (Assignment Sheet #2)

22. List fish and wildlife in your area. (Assignment Sheet #3)

23. Identify wildlife you see in a certain time span. (Assignment Sheet #4)

24. Compile a profile of a wildlife species. (Assignment Sheet #5)

WILDLIFE MANAGEMENT
UNIT V

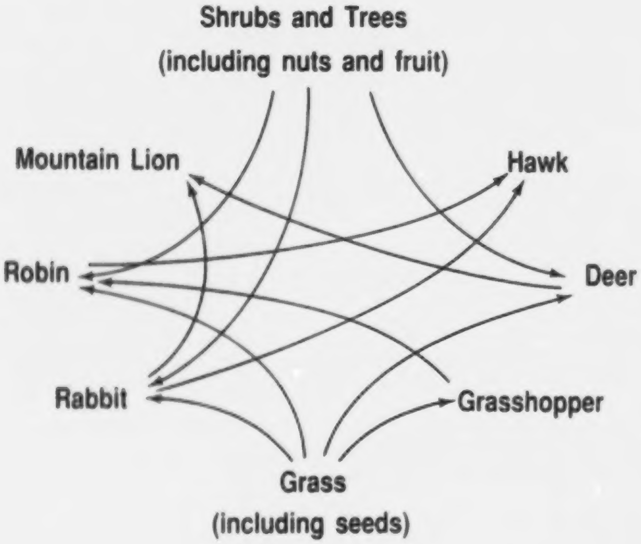
ANSWERS TO TEST

1.

a.	12	f.	21	k.	22	p.	16
b.	14	g.	26	l.	13	q.	8
c.	7	h.	6	m.	2	r.	11
d.	3	i.	5	n.	25	s.	23
e.	4	j.	9	o.	24	t.	18

2. a. Producers
b. Herbivores
c. Carnivores
d. Omnivores

3.


Shrubs and Trees
(including nuts and fruit)
Mountain Lion
Hawk
Robin
Deer
Rabbit
Grasshopper
Grass
(including seeds)

4. a. 50
b. Are not
c. Population
d. Weak
e. Exterminating

ANSWERS TO TEST

5. a. Fur
   b. Hostile
   c. State
   d. Rhode Island
   e. 1878
   f. Predators
   g. Bounties
   h. Habitat

6. a. 1
   b. 4
   c. 2
   d. 5
   e. 3
   f. 7

7. a. R
   b. R
   c. W
   d. W
   e. W
   f. R
   g. U
   h. W
   i. U
   j. U

8. a, d, e, f, i

9. Any four of the following:

   a. Bass
   b. Bluegill
   c. Crappie
   d. Bullhead
   e. Catfish
   f. Pike
   g. Trout
   h. Perch

10. Any eight of the following:

   a. Bat (ozark, gray)
   b. Grizzly bear
   c. Wolf (red, grey)
   d. Black-footed ferret
   e. Swift fox
   f. Jaguar
   g. Jaguarundi
   h. Whooping crane
   i. Bald eagle
   j. Woodpecker (ivory-billed, red-cockaded)
   k. Eskimo curlew
   l. Interior least tern
   m. Peregrine falcon
   n. Bonytail chub

ANSWERS TO TEST

o. Humpback chub
p. Leopard darter
q. Gambusia (big bend, clear creek, pecos)
r. Comanche pupfish
s. Colorado River squawfish
t. Greenback trout
u. Central mudminnow
v. Pearl dace
w. Banded killfish

11. Any five of the following:

a. Illegal hunting
b. Predators
c. Starvation
d. Droughts
e. Storms
f. Diseases
g. Parasites
h. Fires
i. Accidents
j. Human activities including pollution
k. Loss of habitats

12. Any three of the following:

a. Farm around the hill (contours) to control sediment that might enter and ruin ponds, lakes, and streams.
b. Leave fence rows undisturbed to provide cover so wildlife can travel to other areas.
c. Provide farm ponds and tanks for wildlife drinking water.
d. Use windbreaks and shelterbelts to provide habitat for wildlife.
e. Seed legumes and grasses to provide food cover for wildlife.
f. Leave brush and dead (den) trees to provide nesting cover for wildlife.
g. Prevent overgrazing on grassland to protect escape cover, nesting cover, and food for wildlife.
h. Leave crop residue on the land to provide food for wildlife.
i. Provide food plot areas to keep wildlife away from crops.
j. Maintain existing wetlands to assure future wildlife habitat.

13. a, b, d, e, g, h, i

ANSWERS TO TEST

14. Any three of the following:

    a. Reduce the number of destructive animals
    b. Provide fencing or other mechanical barriers
    c. Use frightening techniques
    d. Encourage adequate game harvest by hunters
    e. Adjust agricultural practices
    f. Establish feeding and resting areas on noncrop lands

15. a. T
    b. T
    c. F
    d. F
    e. F

16. a. 5
    b. 2
    c. 3 or 4
    d. 1

17. Any four of the following:

    a. State wildlife, conservation, and natural resource departments
    b. Fish and Wildlife Service
    c. Forest Service
    d. National Park Service
    e. Soil Conservation Service
    f. Corps of Engineers
    g. Bureau of Reclamation
    h. Bureau of Land Management
    i. Environmental Protection Agency

18. Any three of the following:

    a. Audubon Society
    b. Izaak Walton League of America Inc.
    c. National Wildlife Federation
    d. Nature Conservancy
    e. Wildlife Society
    f. Sierra Club
    g. Ducks Unlimited
    h. Quail Unlimited
    i. Pheasants Forever

ANSWERS TO TEST

19. Any three of the following:

    a. Fishery biologist
    b. Wildlife biologist
    c. Refuge manager
    d. Special agent (law enforcement)
    e. Technicians (biological, fish and wildlife)
    f. Conservationist
    g. Zoologist

20-24. Evaluated to the satisfaction of the instructor

WILDLIFE HABITATS
UNIT VI

UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between various wildlife habitats, determine carrying capacity, and determine habitat improvement methods. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to wildlife habitats with the correct definitions.
2. Match the components of a habitat with the correct descriptions.
3. List the objectives of wildlife habitat management.
4. Complete statements concerning habitat management principles.
5. Match common tools and techniques of habitat improvement with the correct uses.
6. Classify actions taken to improve wildlife habitats.
7. List causes of habitat destruction.
8. Match types of wildlife habitats with the correct descriptions.
9. Complete statements concerning lakes, ponds, and pothole habitats.
10. Select true statements concerning river and stream habitats.
11. Complete statements concerning wetland habitats.
12. Complete statements concerning woodland habitats.
13. Select true statements concerning rangeland habitats.
14. Select true statements concerning farmland habitats.
15. Select true statements concerning urban habitats.
16. Layout and identify ways to improve a local habitat. (Assignment Sheet #1)
17. Identify ways to improve a wetland habitat. (Assignment Sheet #2)
18. Determine the carrying capacity of a pond. (Assignment Sheet #3)
19. Determine the carrying capacity of rangeland. (Assignment Sheet #4)

WILDLIFE HABITATS
UNIT VI

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Components of a Habitat — Objective 2

TM 2-3 — Habitat Improvement — Objective 5

TM 4 — Habitat Destruction — Objective 7

TM 5 — Lakes, Ponds, and Pothole Habitat — Objective 9

TM 6 — River and Stream Habitat — Objective 10

TM 7 — Wetland Habitat — Objective 11

TM 8 — Woodland Habitat — Objective 12

TM 9 — Rangeland Habitat — Objective 13

TM 10 — Farmland Habitat — Objective 14

TM 11 — Urban Habitat — Objective 15

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Discuss the habitat required by a specific endangered species.
2. Create an arboretum.
3. Construct waterfowl nesting structures.
4. Obtain information about the National Wildlife Refuge System.

SUGGESTED ACTIVITIES

5. Obtain information about local private organizations that support wildlife habitat.

6. Identify plants in a specific wildlife habitat.

7. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Camp, William G. *Managing Our Natural Resources*. Albany, NY: Delmar Publishers, Inc., 1988.

B. Dietrich, Irvine. *Conservation of Natural Resources*. St. Paul, MN: Webb Publishing Co., 1962.

C. Teague, Richard D. *Wildlife Conservation*, 2nd ed. Washington, D.C.: The Wildlife Society., 1979.

D. Cooperrider, Allen Y. *Inventory and Monitoring of Wildlife Habitat*. U.S. Dept. Interior, Bureau of Land Management Service Center, Denver, CO, 1986.

E. *Wildlife Habitat Improvement Handbook: Forest Service Handbook*. United States Department of Agriculture, 1969.

F. *Making Land Produce Useful Wildlife*, Farmers' Bulletin No. 2035. U.S. Department of Agriculture.

G. *More Wildlife Through Soil and Water Conservation*, Agriculture Information Bulletin No. 175. Soil Conservation Service.

SUGGESTED SUPPLEMENTAL RESOURCES

A. *Basic Field Techniques in Wildlife Management*. Columbus, OH: Agricultural Education Service, 1975.

B. White, Paul F. *Fish and Wildlife Management*. Jefferson City, MO: Missouri Department of Conservation, 1989.

C. Kircher, Harry B. *Our Natural Resources and Their Conservation*, 6th ed. Danville, IL: The Interstate Printers & Publishers, Inc., 1988.

SUGGESTED SUPPLEMENTAL RESOURCES

D. Films and videotapes

1. *America's Wetlands*, A05875/PY. 28 min. © 1981. 16mm film and 1/2", 3/4", or Beta videotapes. Developed by the U.S. Department of the Interior, Fish and Wildlife Service. Discusses the value of America's wetlands to humans and wildlife.

2. *Habitat — A Special Place*, A01929/PY. 28 min. © 1979. 16mm film and 1/2", 3/4", or Beta videotapes. Developed by the U.S. Department of Agriculture. Explores a variety of native environments to learn about "habitats."

   1 and 2 are available from:

   National Audiovisual Center
   National Archives and Records Administration
   Customer Services Section PY
   8700 Edgeworth Drive
   Capitol Heights, MD 20743-3701
   301/763-1896

3. *Estuary*. 12 min. © 1981. 16mm film or video. Produced by the National Film Board of Canada. Details the complex ecology of estuarine life and the importance of wetlands. Available from:

   Bull Frog Films, Inc.
   Oley, PA 19547
   800/543-FROG

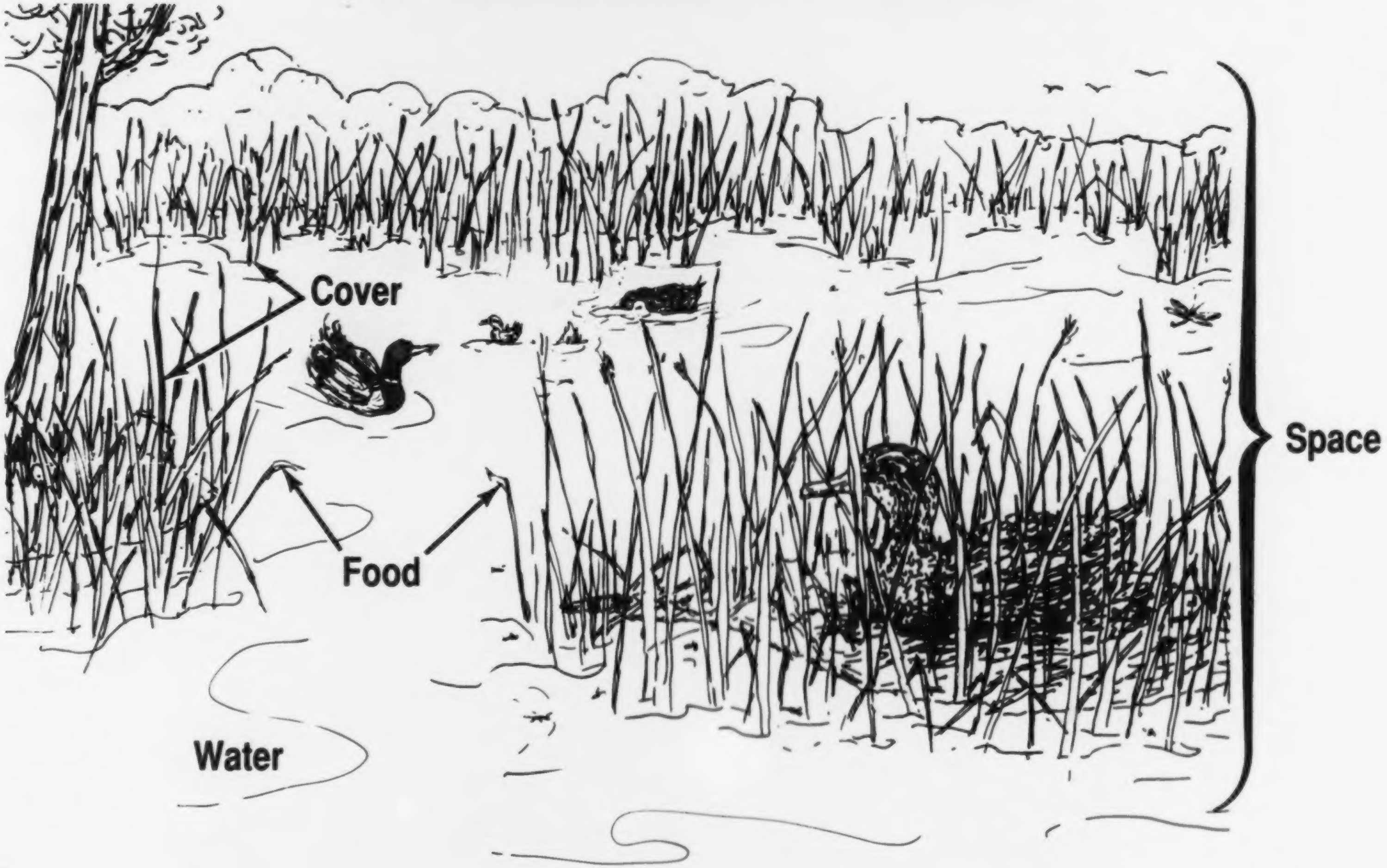
4. *Urban Wildlife*, 20 min. 1/2" and 3/4" video. Discusses co-existence of wild animals and humans in an urban environment. Available from:

   Centre Productions, Inc.
   Distributed by Barr Films
   12801 Schabarum Avenue
   P.O. Box 7878
   Irwindale, CA 91706-7878
   818-338-7878

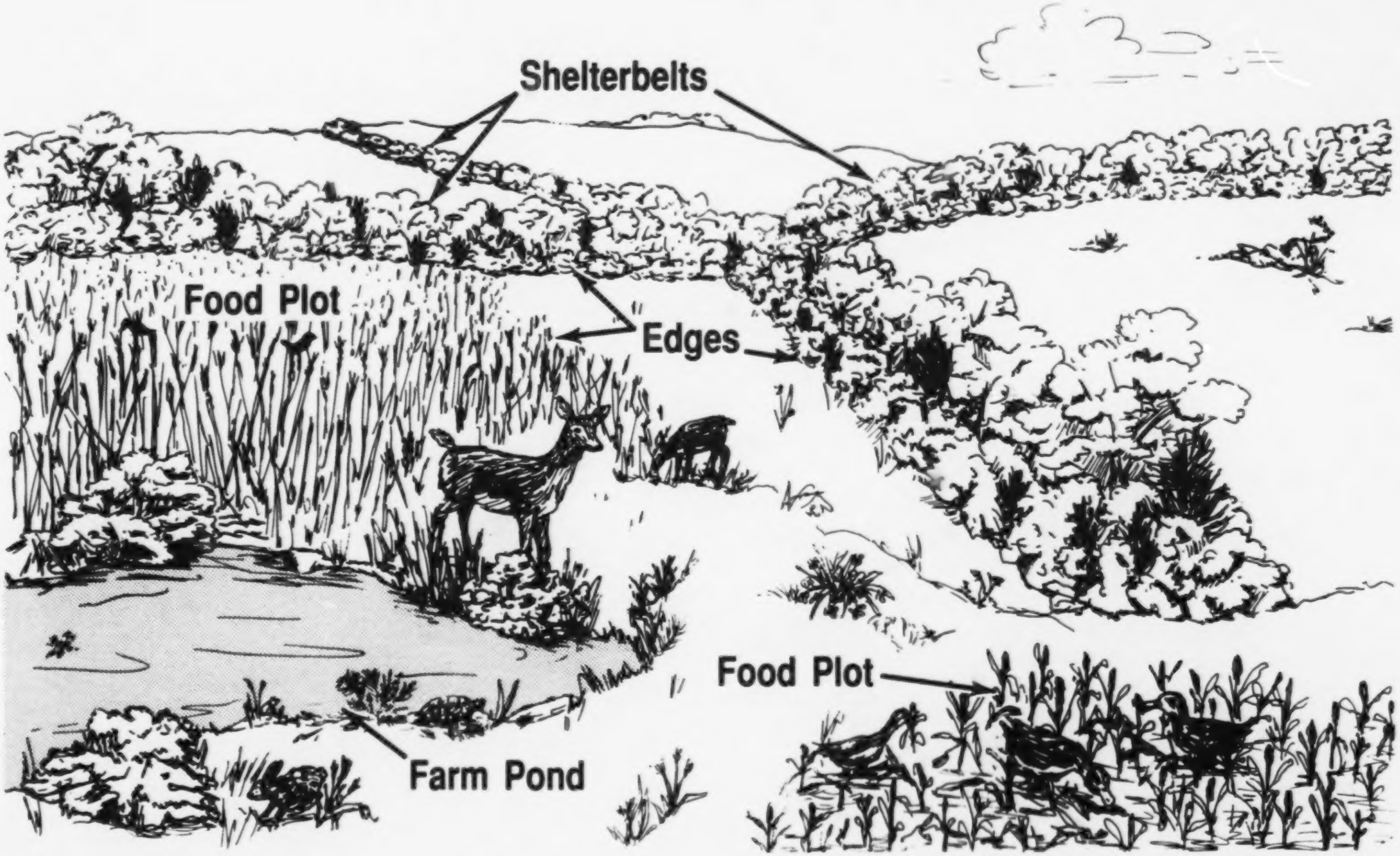
E. Computer software — *Wildlife Series: Limiting Factors and Carrying Capacity*. Relates habitat, wildlife, human effects, and students' personal values. For Apple II (DOS 3.3). Available from:

Instructional Materials Service
Cornell University
24 Roberts Hall
Ithaca, NY 14853-5901
607-255-3002

Components of a Habitat


Cover
Food
Water
Space

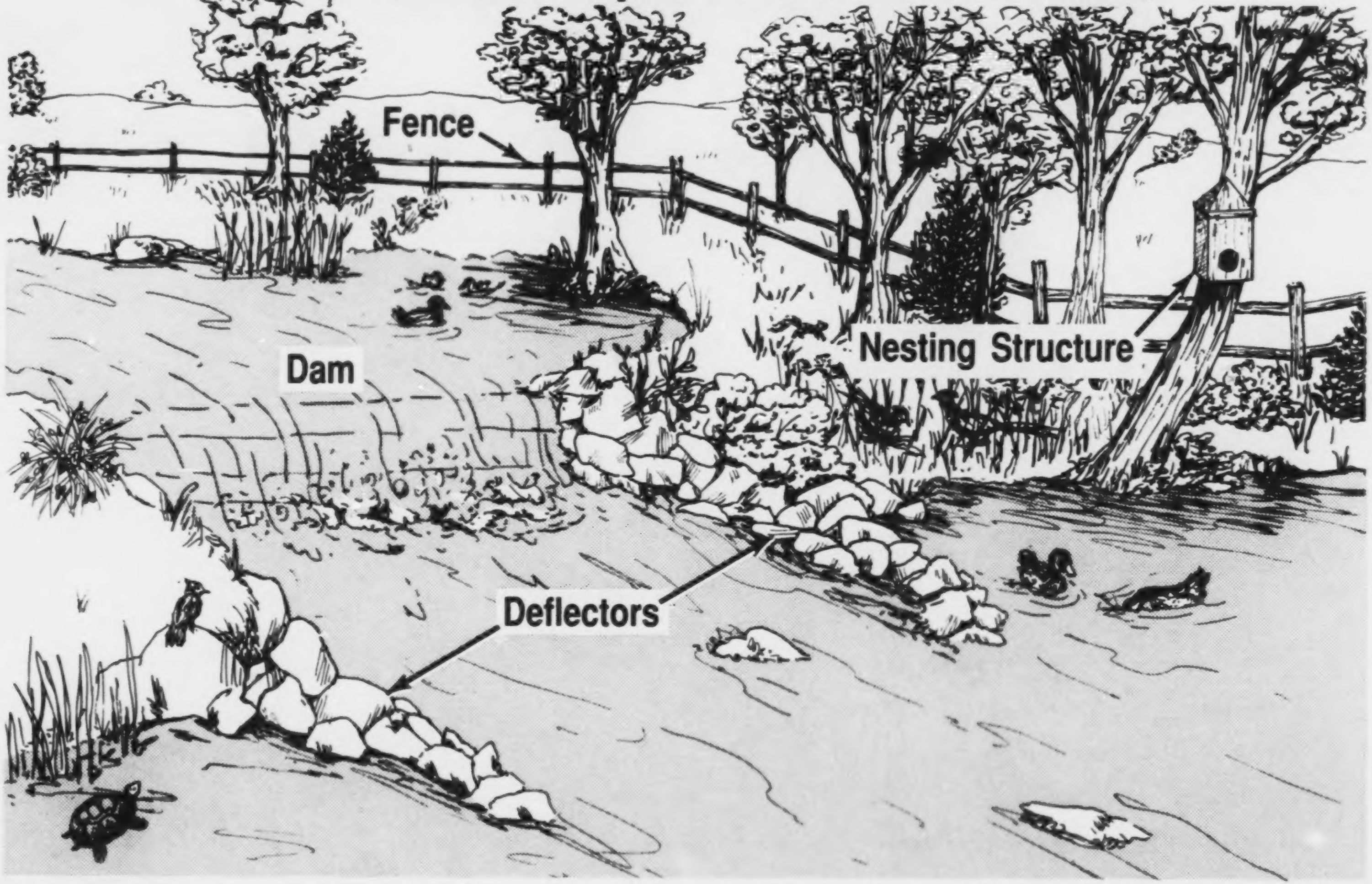
Habitat Improvement


Shelterbelts
Food Plot
Edges
Food Plot
Farm Pond

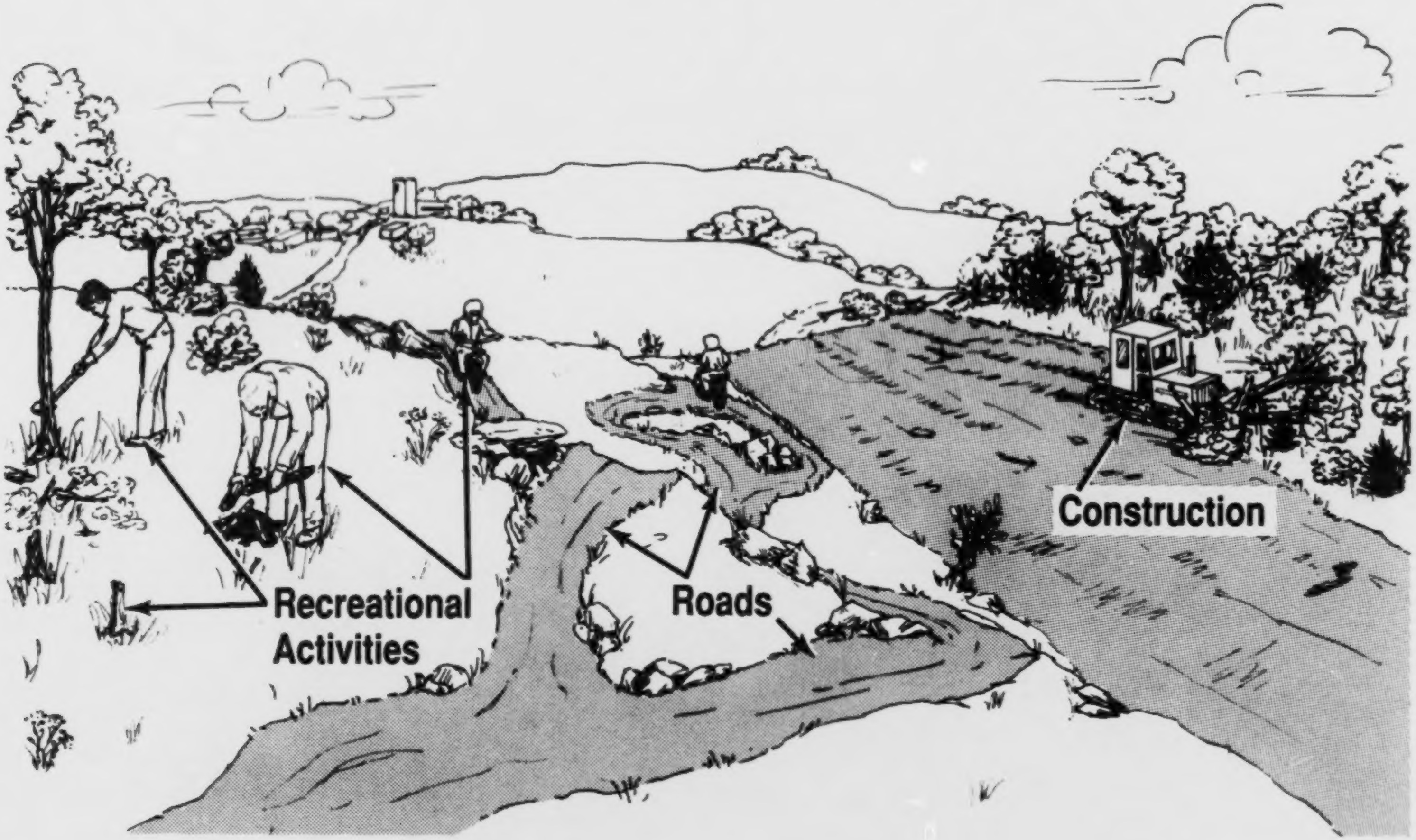
TM 2

NR-263

Habitat Improvement (Continued)


Fence
Nesting Structure
Dam
Deflectors

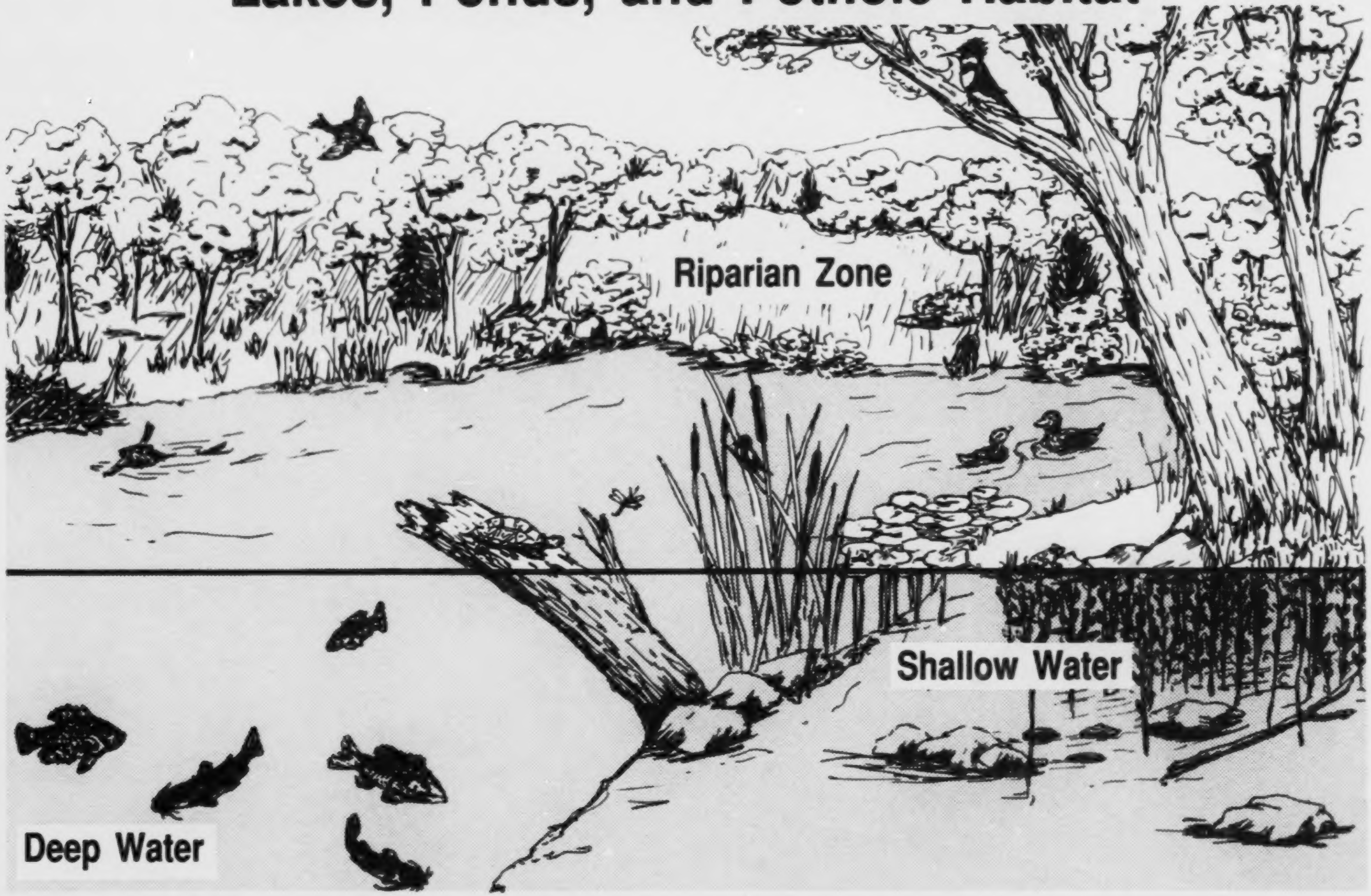
Habitat Destruction


Recreational Activities
Roads
Construction

TM 4

NR-267

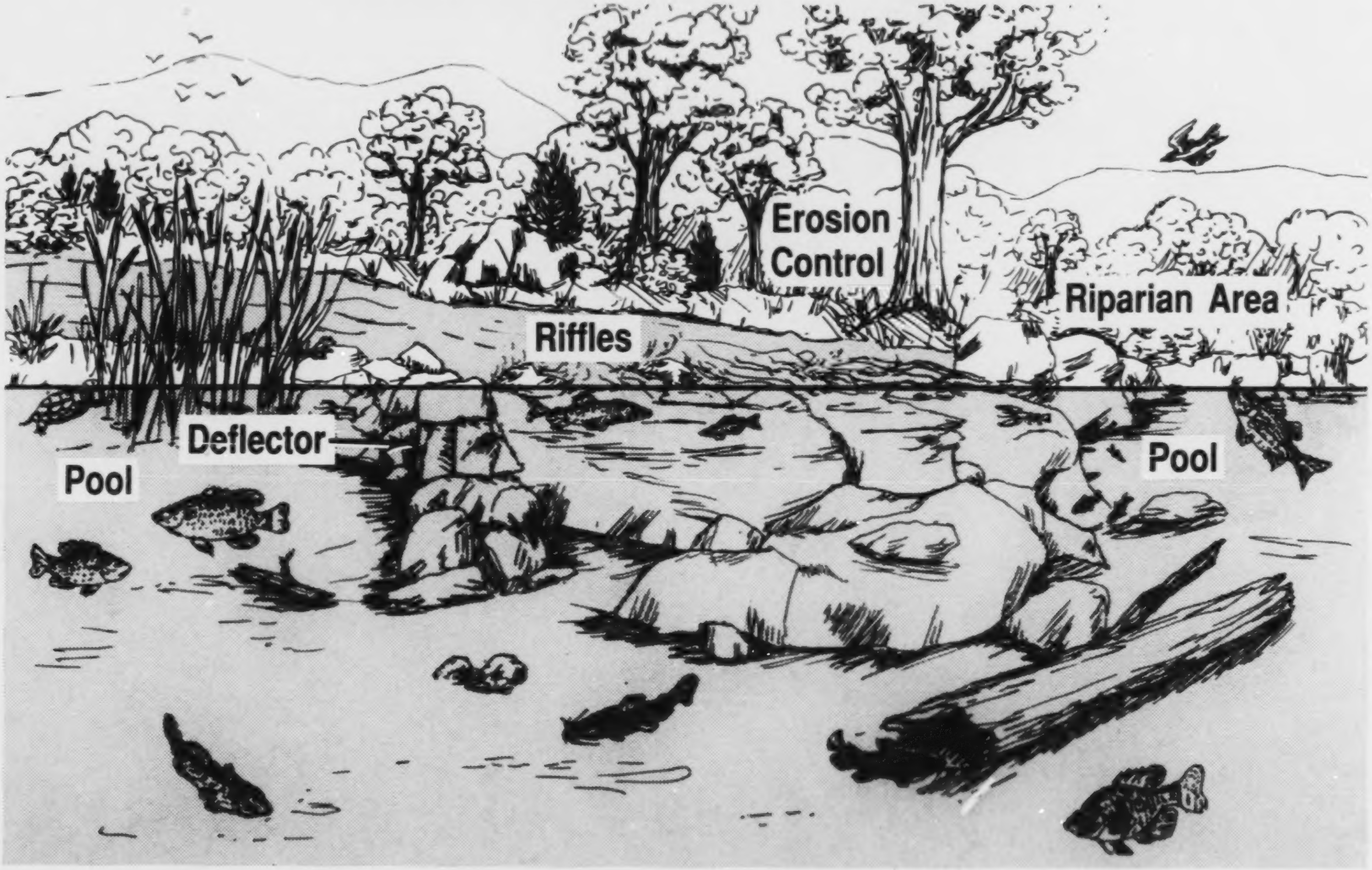
Lakes, Ponds, and Pothole Habitat


Riparian Zone
Shallow Water
Deep Water

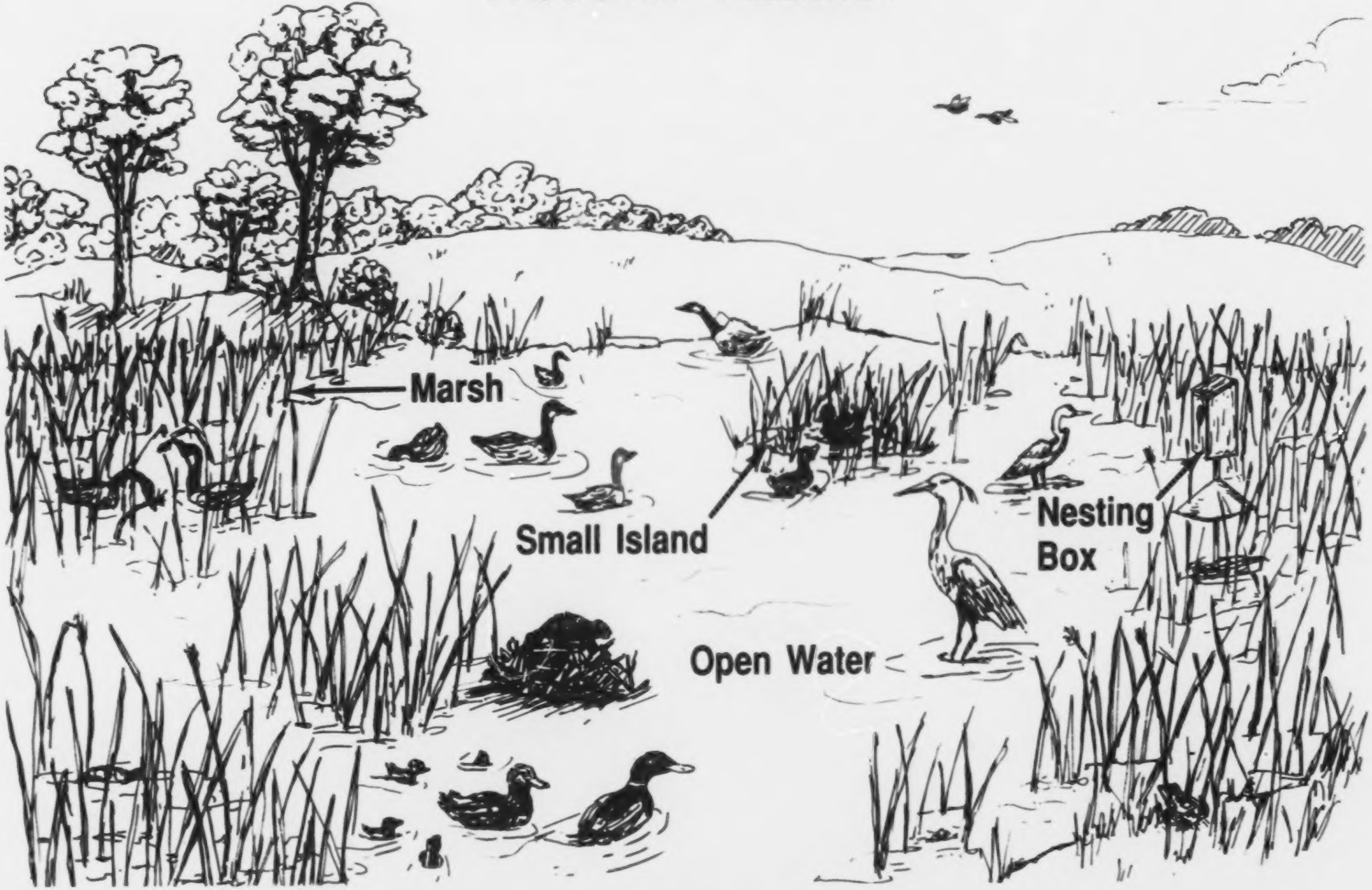
TM 5

NR-269

River and Stream Habitat


Erosion Control
Riparian Area
Riffles
Deflector
Pool
Pool

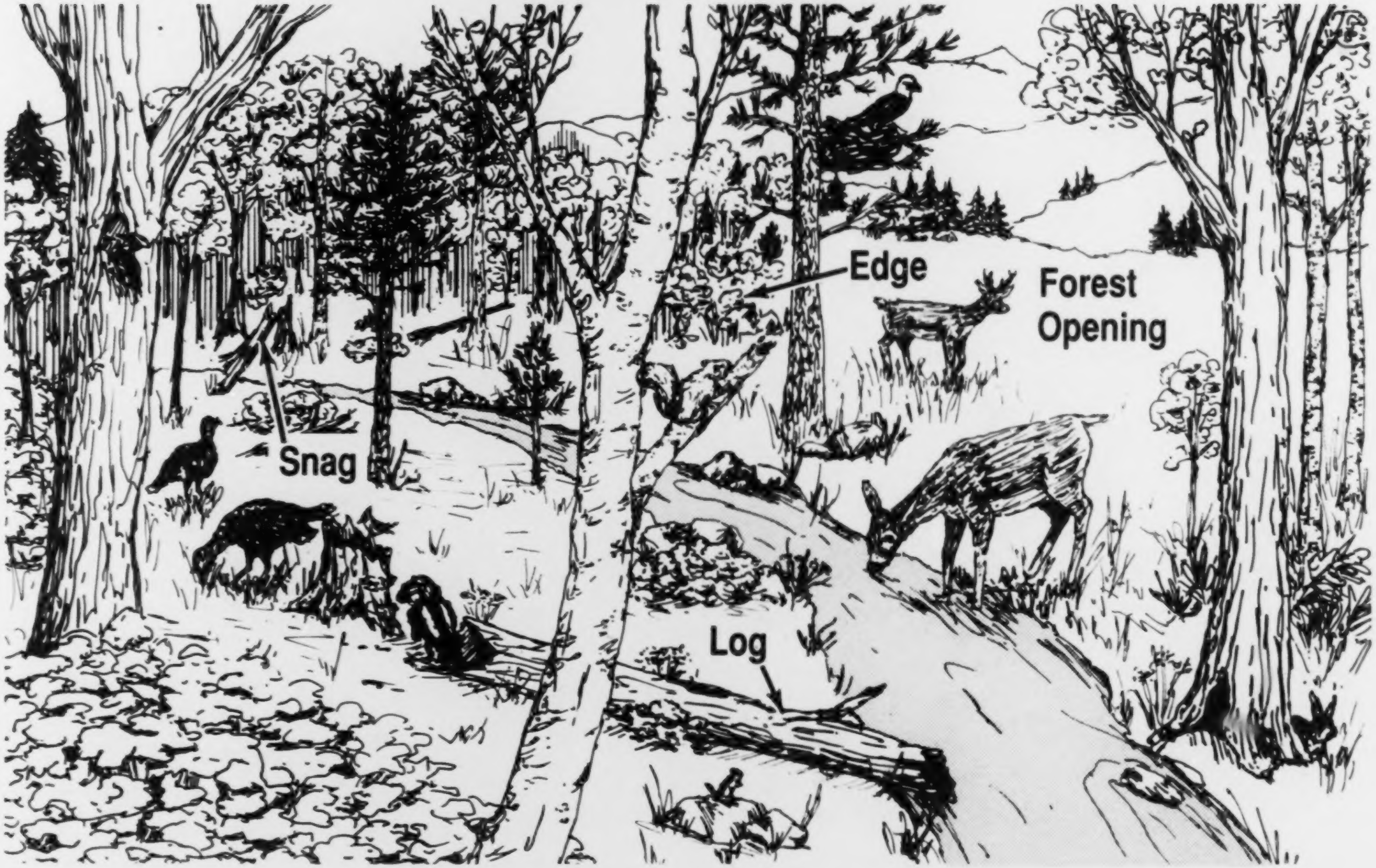
Wetland Habitat


Marsh
Small Island
Nesting Box
Open Water

TM 7

NR-273

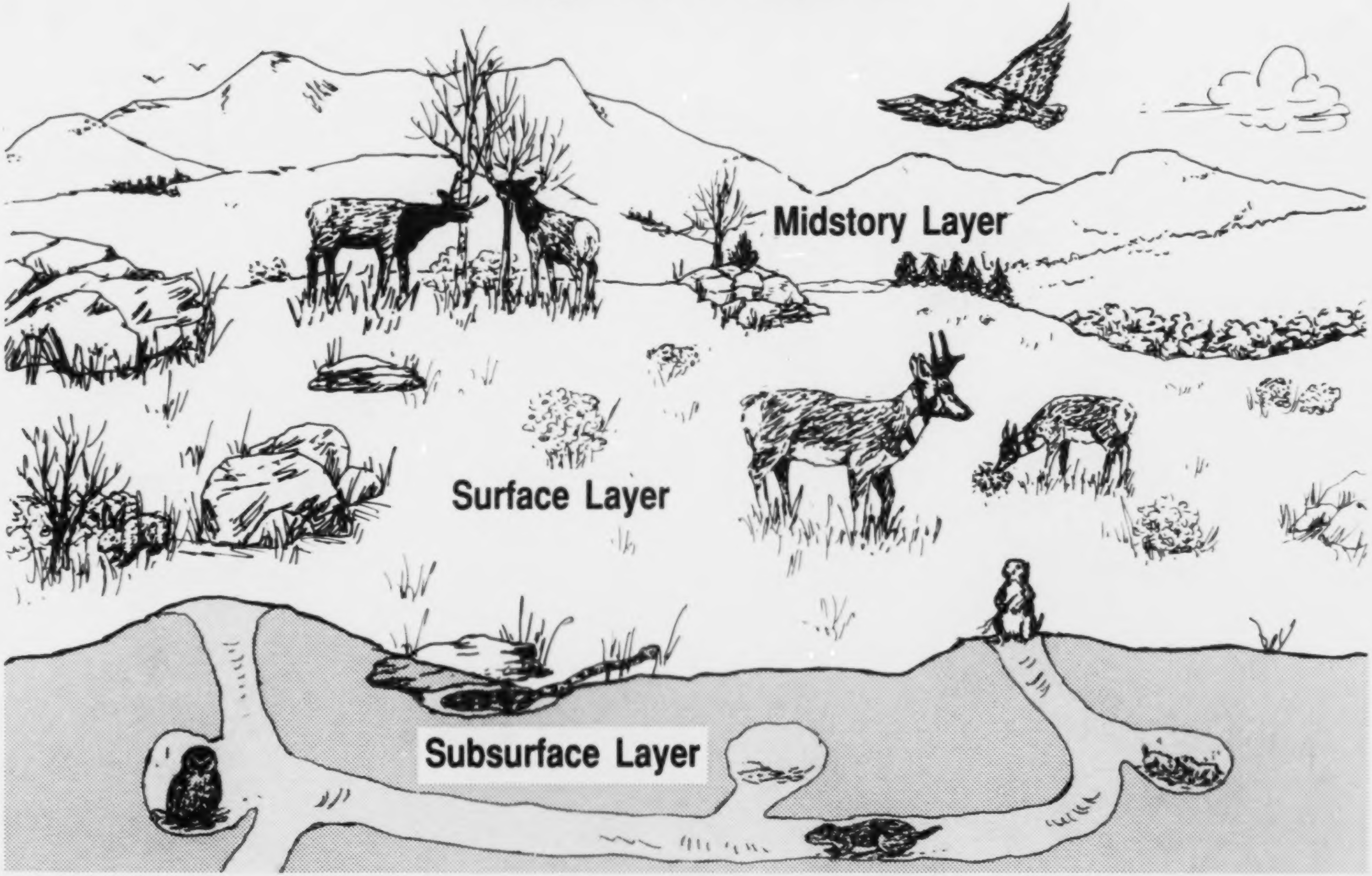
Woodland Habitat


Edge
Forest Opening
Snag
Log

TM 8

NR-275

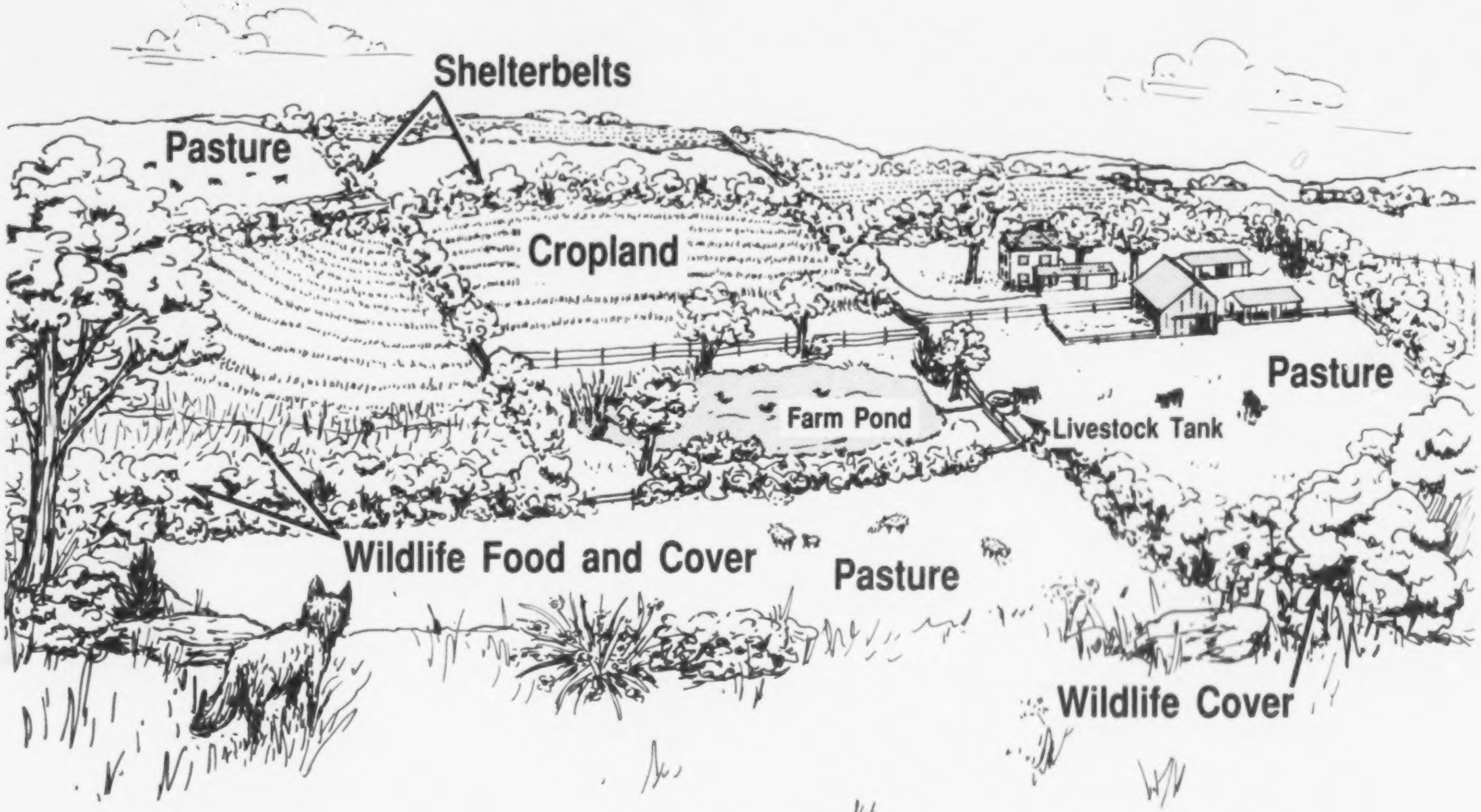
Rangeland Habitat


Midstory Layer
Surface Layer
Subsurface Layer

TM 9

NR-277

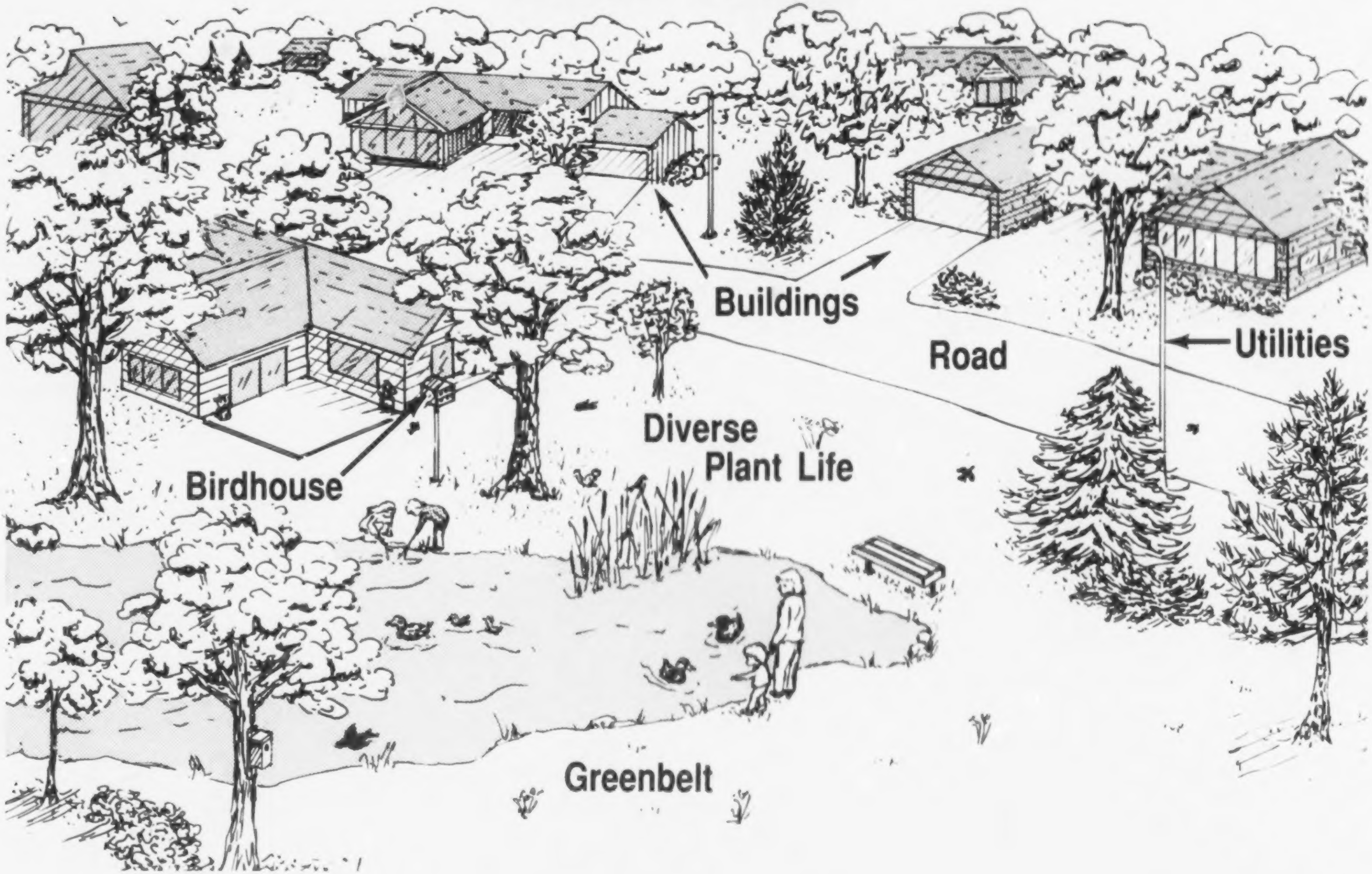
Farmland Habitat


Shelterbelts
Pasture
Cropland
Pasture
Farm Pond
Livestock Tank
Wildlife Food and Cover
Pasture
Wildlife Cover

TM 10

NR-279

Urban Habitat


Buildings
Road
Utilities
Diverse Plant Life
Birdhouse
Greenbelt

WILDLIFE HABITATS
UNIT VI

INFORMATION SHEET

I. **Terms and definitions**

A. Algae — Simple, free-floating water plants

(NOTE: These form the base of the food chain in aquatic habitats.)

B. Aquatic — Growing or living in or upon water

C. Biomass — The amount of living matter (plants and animals) in a given habitat

D. Buffer strip — An area that divides two areas of differing habitat

E. Browse — The leaves, shoots, and twigs of trees and shrubs available for animal consumption

F. Canopy — Leaf area of the woodland

G. Carrying capacity — The maximum number of animals that an area can support

H. Edge — The transitional zone where one cover type ends and another begins

I. Forb — A general name for any fleshy-leafed plant, other than grass, which is found in grasslands and open woodlands

J. Habitat — The area where a plant or animal naturally lives and grows

K. Home range — The area in which an animal lives and travels

L. Limiting factors — Factors that restrict the population potential of a species

M. Mast — Nuts of trees and shrubs (such as oak, hickory, and beech) which are used as food by animals

N. Plankton — Suspended, floating, microscopic plants and animals in the water

O. Release cut — Thinning of old shrub growth to allow new growth

P. Riffles — A shallow area in a stream that causes broken water

Q. Riparian land — The area along the bank of a natural watercourse

R. Spawning — The process by which fish deposit eggs

S. Succession — The progressive development of vegetation which replaces one plant community with another in order to reach a climax condition

T. Territory — The area an animal will defend

INFORMATION SHEET

II. Components of a habitat

A. **Food** — Provides nutrients for growth, maintenance, and reproduction

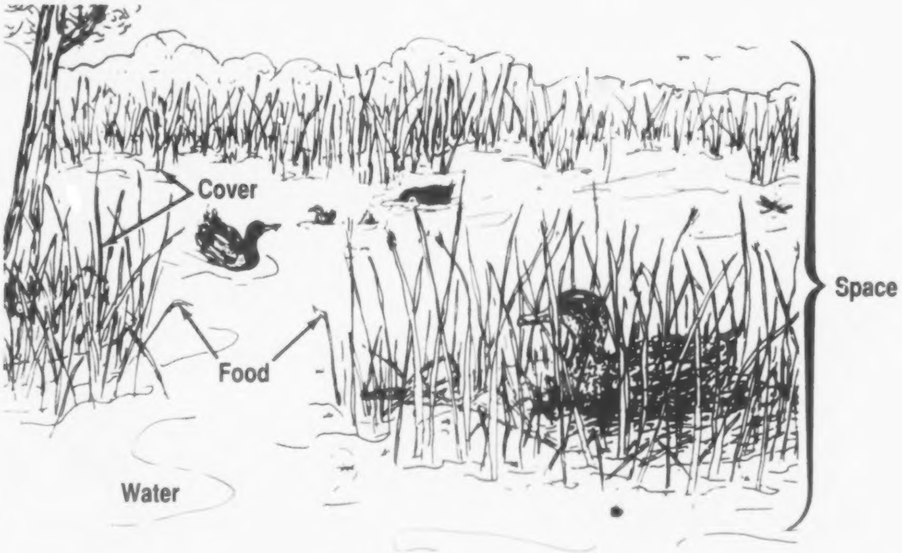
B. **Water** — Needed for blood composition, to regulate body temperature, and to provide nutrient transport throughout the body

C. **Cover** — Vegetation or other material providing protection for the animal

1. Conceals the nest
2. Helps to hide the young
3. Provides resting area
4. Allows escape from predators
5. Protects from adverse environmental conditions

D. **Space** — Amount of area that an animal uses to locate its food, water, and cover (home range)

(NOTE: Space requirements vary according to the animal, season of the year, and quality of the habitat.)



INFORMATION SHEET

III. **Objectives of wildlife habitat management**

A. To maintain a quality habitat as it exists in a natural ecosystem

B. To improve a habitat where it has deteriorated or where a specific habitat component is lacking

IV. **Habitat management principles**

A. Wildlife research helps to determine the habitat requirements of specific wildlife.

B. The specific habitat needs of a species vary in some degree from those of every other kind of species.

C. Some species need a highly specialized type of habitat.

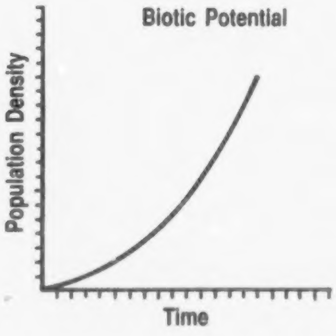
D. When the basic components of a habitat are abundant and ideal, the animal species will reach its maximum potential (biotic potential).

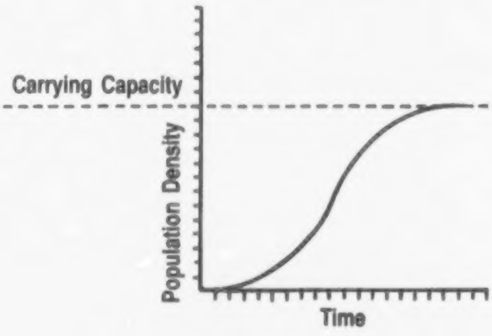
(NOTE: Some species such as rabbits and mice have high biotic potentials, whereas, other species such as grizzly bears and bald eagles have low biotic potentials.)

E. However, species rarely reach their potential because there is almost always an environmental factor that limits the population.

Examples of limiting factors: Shortage of food or water, limited space, inadequate cover

F. Each area of land (habitat) has a certain capacity for the number of animals of any one species that it can support. This is called its carrying capacity.





INFORMATION SHEET

H. When the population in a habitat exceeds the carrying capacity, surplus animals must either move or die.

I. When habitat conditions change, the type and amount of wildlife present may also change.

J. Wildlife species can be maintained only by providing suitable habitats.

K. When habitats are damaged or destroyed, wildlife are threatened and can become endangered or extinct.

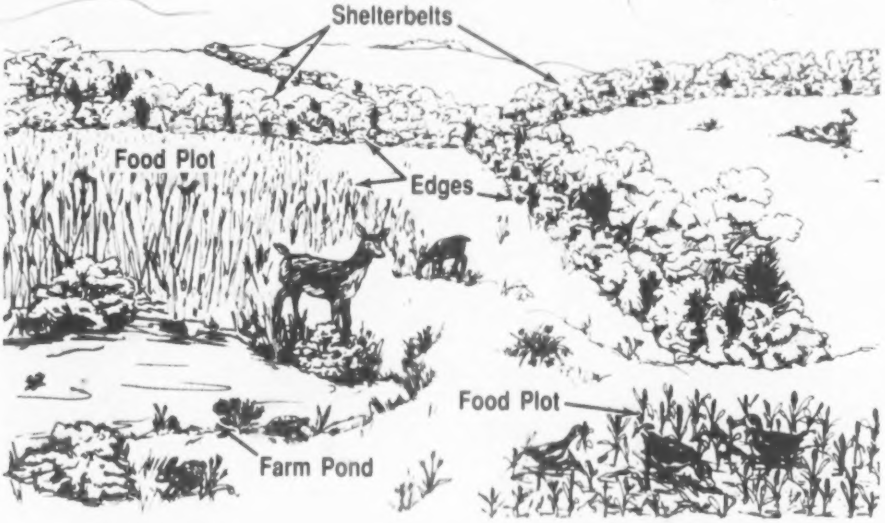
V. **Common tools and techniques used in habitat improvement**

A. Food plots — Planted to provide food and cover habitat.

B. Shelterbelts — Planted to provide escape cover.

C. Farm ponds — Provide a habitat for fish as well as a watering place for other wildlife.

D. Edges — Established to provide a change between types of cover.



INFORMATION SHEET

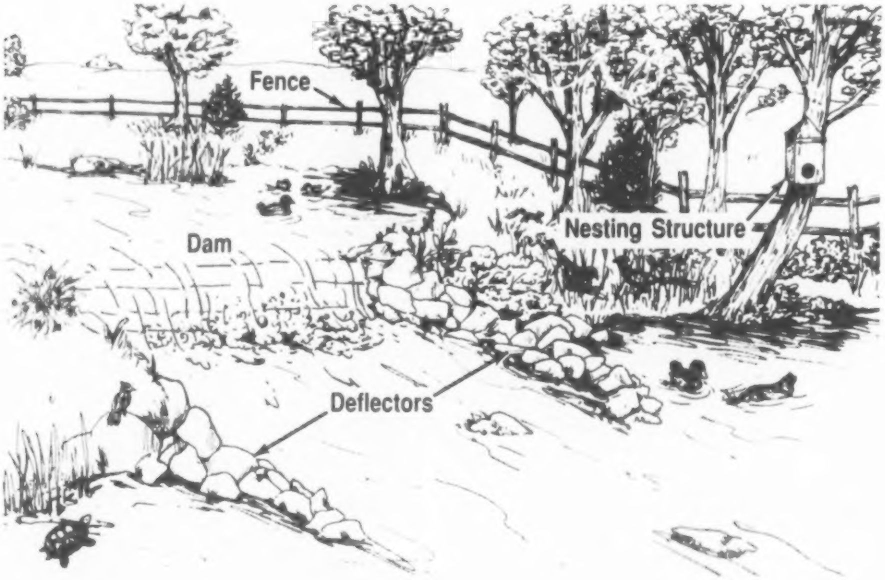
E. Nesting structures — Provide nesting places for species whose natural habitat has been damaged.

(NOTE: Wood ducks were endangered until nesting boxes were provided for them.)

F. Dams — Constructed in a stream to store water for fish and wildlife.

G. Deflectors — Used to control the direction of stream flow.

H. Fences — Used to protect water and its bank from contamination or damage by domestic animals.



I. Heavy equipment — May be used in the removal of unwanted aquatic vegetation from some lakes, or in reshaping land for various wildlife needs

J. Chemicals — Used to change the chemical composition of the water or soil either to encourage or discourage various plant and animal species.

Example: Rotenone is used to poison unwanted fish populations

INFORMATION SHEET

VI. Ways to improve wildlife habitats

A. Food

1. Increase mast or fruit production.
2. Plant shrubs and trees for browse.
3. Plant food plots of grasses and legumes.
4. Provide aquatic plant vegetation.

B. Water

1. Deepen existing water-holding basins.
2. Trench runoff water into basins.
3. Improve springs and water seeps.
4. Build dams.
5. Add tanks, troughs, or wells.
6. Prevent water pollution.
7. Create potholes.
8. Control water levels.

C. Cover

1. Protective cover
    a. Plant trees and shrubs.
    b. Build brush piles.
    c. Build artificial covers (roosts, reefs).
    d. Renovate eroded areas.
    e. Seed bare land areas.
2. Nesting cover
    a. Protect from excessive grazing, fires, and mowing during nesting periods.
    b. Maintain existing dens or nesting trees.
    c. Provide artificial nest structures.

INFORMATION SHEET

VII. Causes of habitat destruction

A. Overgrazing

B. Mining

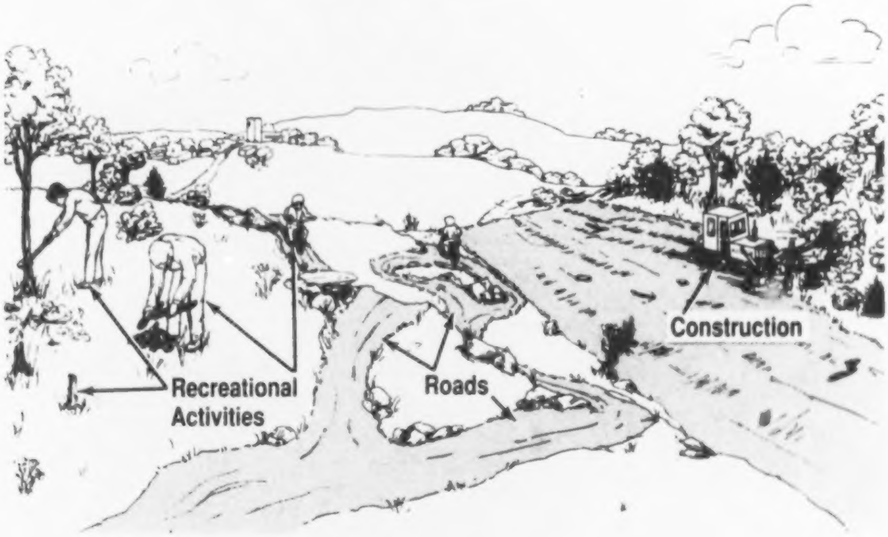
C. Construction (urban and rural)

D. Logging

E. Roads

F. Chemicals

G. Recreational activities



VIII. Types of wildlife habitats

A. Lakes, ponds, and potholes — Bodies of still water

B. Rivers and streams — Bodies of running water

C. Wetland — Land where the water table is usually at or near the surface or the land is covered by shallow water

D. Woodland — Land used primarily for growing trees and shrubs; includes forests, shelterbelts, and hedge rows

E. Rangeland — Land where natural vegetation is mostly grasses, forbs, and shrubs

F. Farmland — Land used for agricultural practices

G. Urban — Land predominantly occupied by man-made structures used for residential, commercial, and industrial purposes

INFORMATION SHEET

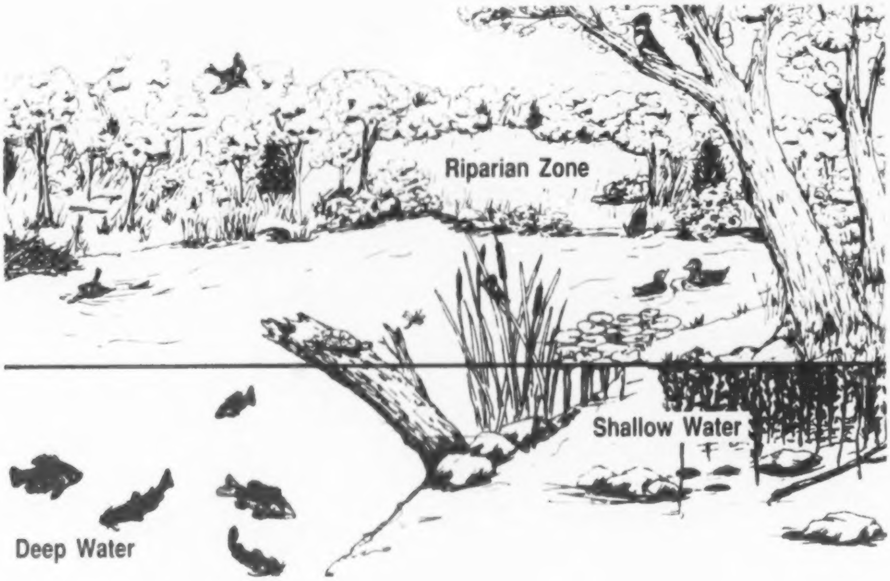
IX. Lakes, ponds, and pothole habitats

A. Components

1. Deep water — Supports plankton and carnivorous fish

2. Shallow water — Supports aquatic vegetation and diverse aquatic populations

3. Riparian zone — Area located on the bank; supports both aquatic and terrestrial (land) plants and animals



B. Protecting lakes, ponds, and pothole habitats

1. Fence shoreline to control livestock grazing and watering.

2. Control erosion in the watershed.

3. Reduce sediment into the lake by providing a sediment basin for all feeder streams.

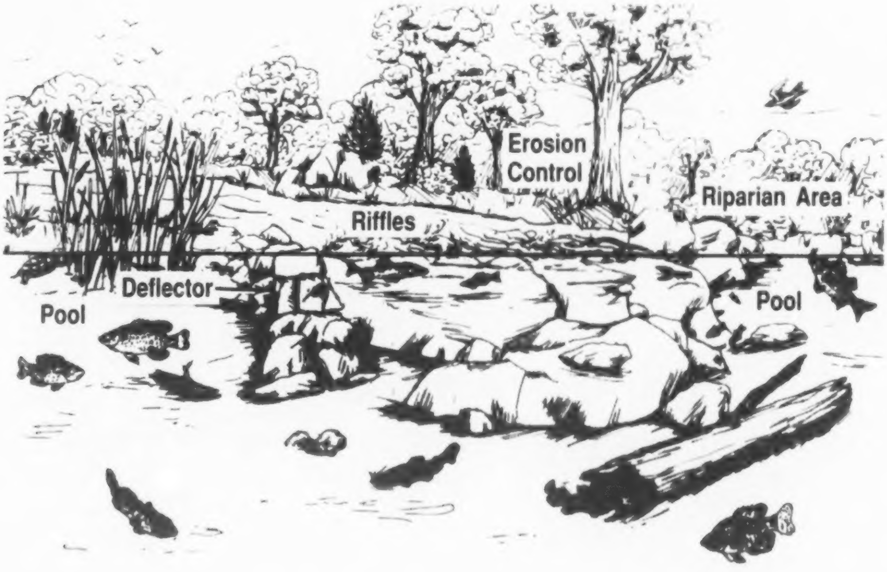
4. Control weeds in shallow areas.

INFORMATION SHEET

X. River and stream habitats

A. Components

1. Streamflow pattern — A continuous flow of water with moderate spring runoff is best.
2. Instream flow — A certain amount of water is needed to maintain stream habitat.
3. Streambank stability — Eroding streambanks allow sediment to ruin the streambed.
4. Riffles — Provide food and spawning areas for fish.
5. Pools — Provide resting areas and shelter for fish.
6. Streambed — Provide area for fish egg incubation.
7. Stream width/depth — Narrow, deep streams increase available habitat for fish.
8. Water temperature — A cooler temperature allows for more dissolved oxygen for fish.
9. Riparian area — Is a breeding ground for insects used as food for fish.



INFORMATION SHEET

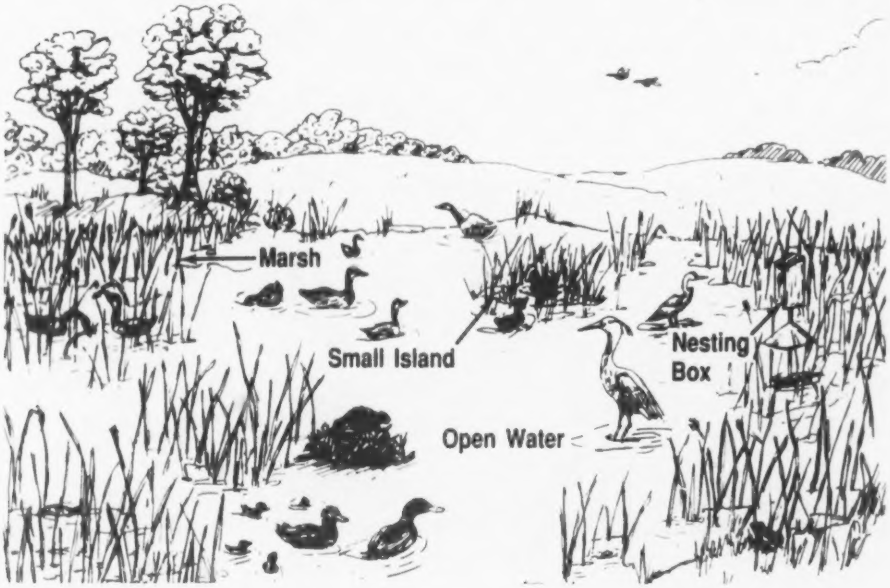
B. Protecting river and stream habitats

1. Fence to protect from livestock grazing and watering.
2. Control erosion in the watershed to reduce silting into stream or river.
3. Control streambank erosion by planting trees and shrubs and by placing rocks and stones along the edge.
4. Remove debris lodged on inside curves of the stream that restrict water flow.
5. Use deflectors to create natural pools.

XI. Wetland habitats

A. Components

1. Potholes and marsh — An ideal wetland has one-third open water potholes and two-thirds marsh.
2. Plant communities — The high concentration of nutrients in wetlands helps to increase the productivity of the vegetation.
3. Size — Larger areas tend to provide more diverse habitat for more types of wildlife.
4. The level of water usually fluctuates seasonally which will affect the type and number of wildlife at those times.



INFORMATION SHEET

B. Protecting wetland habitats

1. Provide a dependable water supply.
2. Control water levels.
3. Protect area from too much grazing that can destroy valuable food and cover.
4. In wetlands that are overgrown, provide open areas by removing vegetation in 50 foot wide strips.
5. Provide nesting and resting sites.

   Examples:

   - Sandbars
   - Small islands
   - Anchored floating logs
   - Rock piles
   - Old bales
   - Nesting boxes

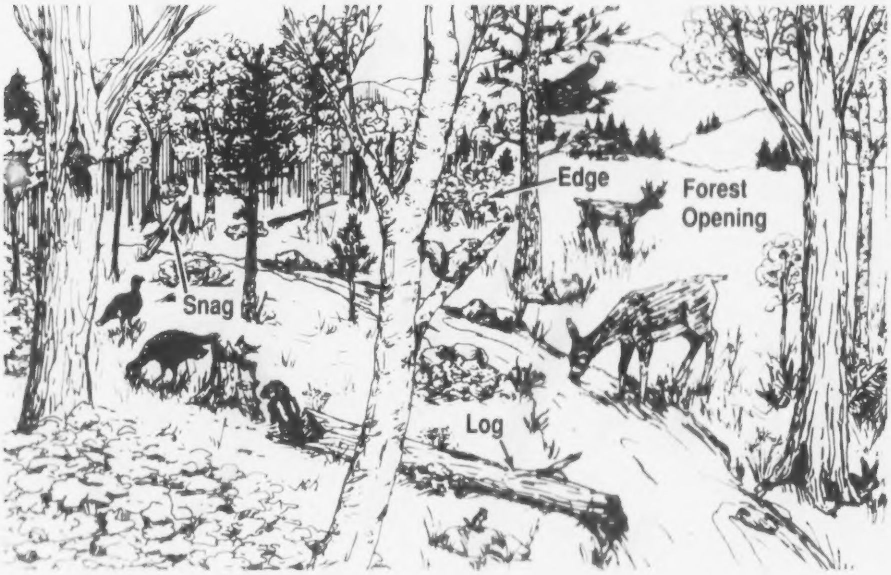
6. Plant desirable vegetation.

XII. Woodland habitats

A. Components

1. Trees — Deciduous and evergreen trees of various ages and sizes.
2. Snags — Dead or partly dead trees.
3. Logs — Dead trees or portions of trees lying on the forest floor.
4. Edges — Preferred by large numbers of wildlife.
5. Forest openings — Areas that do not support trees but provide a source of diversity within the forest.

INFORMATION SHEET



B. Protecting woodland habitats

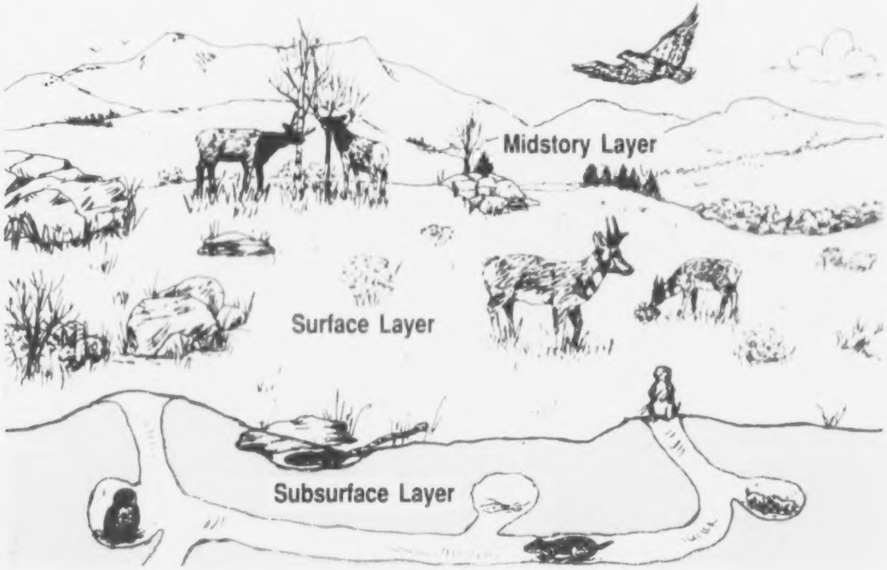
1. Protect from unwanted fire.
2. Protect from overgrazing.
3. Selectively cut trees.
4. Leave den trees when cutting hardwood timber.
5. Pile brush near the edge of the woods.
6. Release cut to increase production of nuts and other tree seeds useful to wildlife.
7. Cut trees out of woodland edges to increase the growth of shrubs for food and cover.

INFORMATION SHEET

XIII. Rangeland habitats

A. Components

1. Subsurface layer — Includes area suitable for burrow or tunnel construction.
2. Surface layer — Includes short, mid, and tall grass species.
3. Midstory layer — Includes deciduous and evergreen shrubs.



B. Protecting rangeland habitats

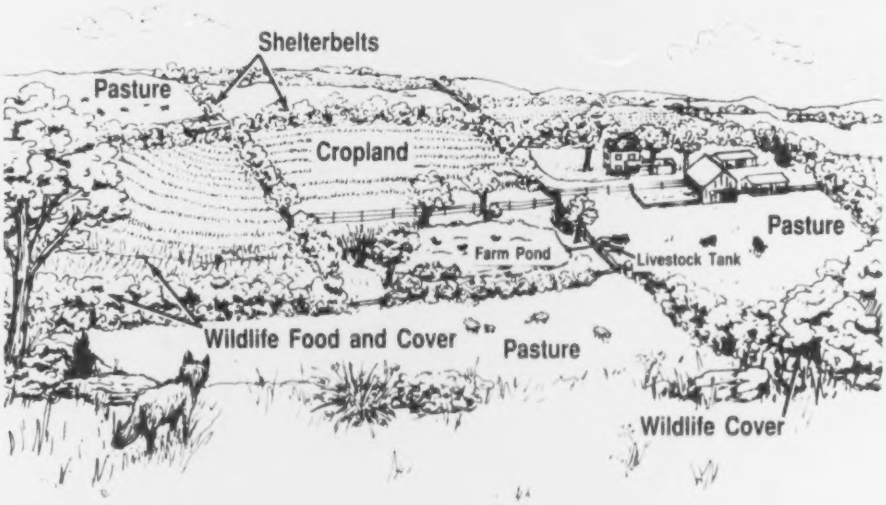
1. Protect from unwanted fires.
2. Protect from overgrazing.
3. Reseed and renovate grasses.
4. Construct walkways in marshy rangeland.
5. Remove only part of the brush and shrubs.
6. Fertilize to increase plant growth.
7. Provide areas for watering.
8. Provide salt.

INFORMATION SHEET

XIV. Farmland habitats

A. Components

1. Cropland
2. Pasture
3. Shelterbelts


Shelterbelts
Pasture
Cropland
Pasture
Farm Pond
Livestock Tank
Wildlife Food and Cover
Pasture
Wildlife Cover

B. Protecting farmland habitats

1. Provide wildlife with habitat areas so they do not reduce crops meant for production.
2. Protect wildlife areas from grazing by domestic animals.
3. Plant trees and shrubs.
4. Maintain a source of water.
5. Perform good land management practices that prevent soil erosion.
6. Provide shelterbelts.
7. Seed marginal lands to grasses.
8. Provide food or cover plots.
9. Construct farm ponds.
10. Control burning.

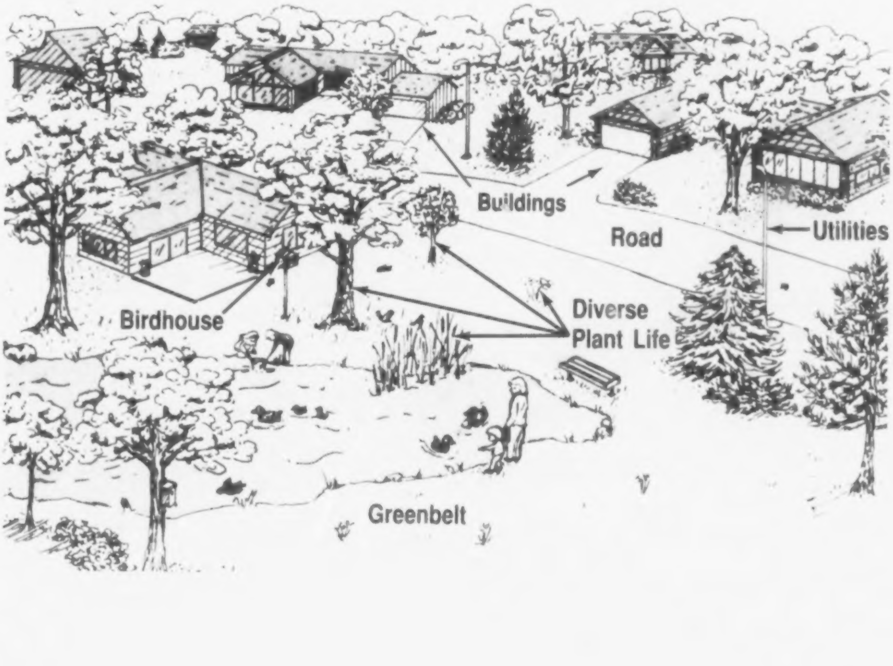
INFORMATION SHEET

11. Prevent overgrazing of pastures.
12. Restrict clean mowing of pastures and fence rows.
13. Evaluate removal of brush.

XV. Urban habitats

A. Components

1. Buildings
2. Landscaped areas and lawns
3. Utilities
4. Transportation (roads and vehicles)
5. Natural areas such as parks, greenbelts, and undeveloped areas
6. People and pets


Buildings
Road
Utilities
Birdhouse
Diverse Plant Life
Greenbelt

INFORMATION SHEET

B. Protecting urban habitats

1. Plant trees and shrubs of diverse species preferred by wildlife for food and cover, especially on edges of property.

   (NOTE: Plants with greater diversity will attract more kinds of wildlife.)

2. Provide steady water sources at ground level.
3. Use chemicals (fertilizers and pesticides) conservatively.
4. Provide bird houses, feeders, and baths.
5. Restrict free roaming pets.
6. Use greenbelts (undisturbed areas) in new urban developments to provide areas for wildlife.

WILDLIFE HABITATS
UNIT VI

ASSIGNMENT SHEET #1 — LAYOUT AND IDENTIFY WAYS TO IMPROVE A LOCAL HABITAT

NAME ______________________ SCORE ________

EVALUATION CRITERIA

Criteria	Rating
Design is accurate	______
Improvements are appropriate	______
Assignment is neat and completed on time	______

Directions: Draw the layout for either your school and school grounds or your home and surrounding grounds or land. Add details to your plan of ways to improve that habitat to attract wildlife. Remember the four basic components of a habitat. You may need to research about the wildlife you are trying to attract to find out what they like and need in their habitat.

WILDLIFE HABITATS
UNIT VI

ASSIGNMENT SHEET #2 — IDENTIFY WAYS TO IMPROVE A WETLAND HABITAT

NAME ______________________________ SCORE __________

Directions: Using the information in this unit, determine the proper improvements to be made to the following wetland habitat conditions.

a. The wetland is dry part of the year. ______________________

b. The wetland receives excess flooding during the spring. ______________________

c. Grazing livestock are polluting the area. ______________________

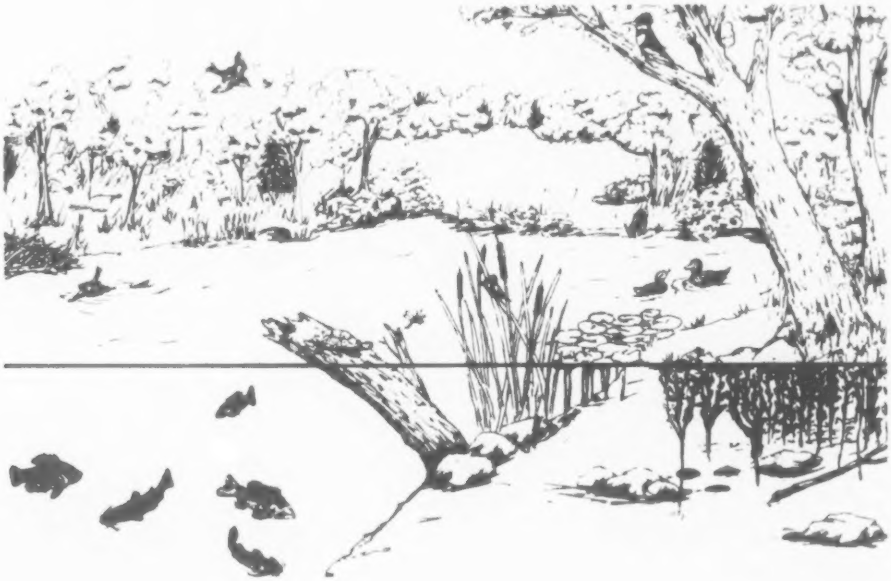
d. Part of the wetland is overgrown with no open water. ______________________

WILDLIFE HABITATS
UNIT VI

ASSIGNMENT SHEET #3 — DETERMINE THE CARRYING CAPACITY OF A POND

NAME ______________________________ SCORE __________

Directions: Using the information provided, determine the amount of each fish that a pond might support.



The bluegill population that this pond can support is 200 lbs per acre. Consider that the amount of food, cover, and space remain the same.

a. The same pond can support only 1/4 the amount of bass. The capacity of the pond for bass is __________ pounds per acre.

b. The same pond can support only 1/20 the amount of northern pike. The capacity of the pond for northern pike is __________ pounds per acre.

c. Theoretically, the pond can support more, but smaller, bluegills. If the pond supports two hundred 1-pound bluegills, it should be able to support __________ 1/2 pound bluegills.

WILDLIFE HABITATS
UNIT VI

ASSIGNMENT SHEET #4 — DETERMINE THE CARRYING CAPACITY OF RANGELAND

NAME ______________________________ SCORE __________

Directions: Using the following information, determine the carrying capacity of a rangeland habitat.

This rangeland has the capacity to support 100 cows.

Livestock to wildlife ratios

1 cow = 1 buffalo
= 2 elk
= 3 deer
= 4 bighorn sheep
= 4 antelope

a. What is the capacity of the range for buffalo? ____________________

b. What is the capacity of the range for elk? ____________________

c. What is the capacity of the range for deer? ____________________

d. What is the capacity of the range for bighorn sheep? ____________________

e. What is the capacity of the range for antelope? ____________________

WILDLIFE HABITATS
UNIT VI

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Evaluated according to the stated criteria

Assignment Sheet #2

a. Provide a dependable water supply

b. Control water levels

c. Protect from too much grazing that can destroy valuable food and cover

d. In wetlands that are overgrown, provide open areas by removing vegetation in 50 foot wide strips

Assignment Sheet #3

a. 50

b. 10

c. 400

Assignment Sheet #4

a. 100

b. 200

c. 300

d. 400

e. 400

WILDLIFE HABITATS
UNIT VI

TEST

NAME ______________________________ SCORE __________

1. Match the terms on the right with the correct definitions.

_____a. The area an animal will defend

_____b. The process by which fish deposit eggs

_____c. Thinning of old shrub growth to allow new growth

_____d. The leaves, shoots, and twigs of trees and shrubs available for animal consumption

_____e. The area where a plant or animal naturally lives and grows

_____f. Simple, free-floating water plants

_____g. The progressive development of vegetation which replaces one plant community with another in order to reach a climax condition

_____h. Nuts of trees and shrubs which are used as food by animals

_____i. Factors that restrict the population potential of a species

_____j. Growing or living in or upon water

_____k. A shallow area in a stream that causes broken water

_____l. The area along the bank of a natural watercourse

_____m. Suspended, floating, microscopic plants and animals in the water

_____n. The maximum number of animals that an area can support

_____o. A general name for any fleshy-leafed plant, other than grass, which is found in grasslands and open woodlands

1. Algae
2. Aquatic
3. Biomass
4. Buffer strip
5. Browse
6. Canopy
7. Carrying capacity
8. Deflector
9. Edge
10. Forb
11. Habitat
12. Home range
13. Limiting factors
14. Mast
15. Mitigate
16. Plankton
17. Release cut
18. Riffles
19. Riparian land
20. Spawning
21. Succession
22. Territory

TEST

2. Match the components of a habitat with the correct descriptions.

_____a. Provides nutrients for growth, maintenance, and reproduction

_____b. Needed for blood composition, to regulate body temperature, and to provide nutrient transport throughout the body

_____c. Amount of area that an animal uses to locate its basic requirements

_____d. Vegetation and other material providing protection for the animal

1. Cover
2. Food
3. Space
4. Water

3. List one objective of wildlife habitat management. ______________________________

____

____

4. Select true statements concerning habitat management principles by placing a T or F next to the true or false statements.

______a. Wildlife research helps to determine the habitat requirements of specific wildlife.

______b. Most species require the same type of habitat.

______c. When the basic components of a habitat are abundant and ideal, the animal species will reach its maximum (biotic) potential.

______d. Environmental factors limit the potential of an animal species population.

______e. All land has the same carrying capacity for all animal species.

______f. Surplus animals always die.

______g. When habitat conditions change, the type and amount of wildlife present remain the same.

______h. Wildlife species can be maintained only by moving them to more suitable habitats.

TEST

5. Match the tools of habitat improvement with the correct uses.

______a. Provide a habitat for fish as well as a watering place for other wildlife

______b. Used to change the composition of the water or soil either to encourage or discourage various plant and animal species

______c. Provide nesting places for species whose natural habitat has been damaged

______d. Established to provide a change between types of cover

______e. Planted to provide food and cover habitat

______f. Used to protect water and its bank from contamination or damage by domestic animals

______g. Used to control the direction of stream flow

1. Chemicals
2. Dams
3. Deflectors
4. Edges
5. Farm ponds
6. Fences
7. Food plots
8. Heavy equipment
9. Nesting structures
10. Shelterbelts

6. Classify actions taken to improve wildlife habitats according to those that would improve the food, water, or cover components. Place the following symbols next to the appropriate actions:

- F — Food improvements
- W — Water improvements
- C — Cover improvements

______a. Deepen existing water-holding basins

______b. Build dams

______c. Provide artificial nest structures

______d. Build artificial roosts or reefs

______e. Increase mast or fruit production

______f. Plant plots of grasses and legumes

______g. Protect from excessive grazing, fires, and mowing

______h. Add tanks, troughs, or wells

TEST

______i. Maintain existing dens or nesting trees

______j. Create potholes

7. List four causes of habitat destruction.

a. ____

b. ____

c. ____

d. ____

8. Match types of wildlife habitats with the correct descriptions.

_____a. Land used for agricultural practices

_____b. Land where the water table is usually at or near the surface or the land is covered by shallow water

_____c. Land used primarily for growing trees and shrubs

_____d. Bodies of running water

_____e. Land predominantly occupied by man-made structures used for residential, commercial, and industrial purposes

_____f. Land where natural vegetation is mostly grasses, forbs, and shrubs

1. Farmland
2. Lakes, ponds, and potholes
3. Rangeland
4. Rivers and streams
5. Urban
6. Wetland
7. Woodland

9. Complete the following statements concerning lakes, ponds, and pothole habitats by circling the correct words.

a. The (shallow, deep) area supports plankton and carnivorous fish.

b. The (shallow, deep) area contains aquatic vegetation and diverse aquatic populations.

c. Ways to protect these habitats include the following:

1) Fence shoreline to control (livestock, birds) from using it for watering.

2) Control erosion in the (watershed, mountains).

3) Reduce sediment into the lake by providing a sediment (filter, basin) for all feeder streams.

4) Control weeds in (shallow, deep) areas.

TEST

10. Select true statements concerning river and stream habitats by placing a T or F next to the true or false statements.

_______a. The best streamflow pattern is an intermittent flow of water with heavy spring runoff.

_______b. A certain amount of water is needed to maintain stream habitat.

_______c. Eroding streambanks allow sediment to ruin the streambed.

_______d. Riffles provide food and spawning areas for fish.

_______e. Riparian areas are breeding areas for pests and should be chemically destroyed.

_______f. Cooler temperatures allow less dissolved oxygen for fish.

_______g. Fence to protect these habitats from livestock grazing and watering.

11. Complete the following statements concerning wetland habitats by circling the correct answers.

    a. The high concentration of nutrients in wetlands helps to (increase, decrease) the productivity of vegetation.

    b. Larger wetland areas tend to provide (more, less) diverse habitat for more types of wildlife.

    c. Protect area from too (little, much) grazing that can destroy valuable food and cover.

    d. In wetlands that are overgrown, provide open areas by removing vegetation in (50, 100) foot wide strips.

12. Complete the following statements concerning woodland habitats by circling the correct words.

    a. Edges are (avoided, preferred) by large numbers of wildlife.

    b. Dead or partly dead trees are called (snags, stumps).

    c. Areas that do not support trees but provide a source of diversity within the forest are called (canopies, openings).

    d. To protect these habitats,

        1) Overgrazing should be (avoided, allowed).

        2) Brush should be (piled near edge, disposed of).

TEST

13. Select true statements concerning rangeland habitats by placing a T or F beside the statements that are true or false.

    ______a. The subsurface layer includes the area suitable for burrow or tunnel construction.

    ______b. The midstory layer includes short, mid, and tall grass species.

    ______c. Rangelands should be protected from unwanted fires.

    ______d. Allow free grazing in marshy rangeland.

    ______e. Clear the land of all brush and shrubs.

    ______f. Build ponds for watering.

14. Select true statements concerning farmland habitats by placing a T or F beside the statements that are true or false.

    ______a. Components of the farmland habitat include cropland, wetland, and woodland.

    ______b. Allow wildlife areas to be grazed by domestic animals.

    ______c. Seed marginal lands to grasses.

    ______d. Drain farm ponds.

    ______e. Allow overgrazing of pastures.

15. Select true statements concerning urban habitats by placing a T or F next to the true or false statements.

    _____a. The basic components of an urban habitat include buildings, utilities, transportation, people, and pets.

    _____b. One way to protect these habitats is to remove trees and shrubs.

    _____c. Steady water sources should be provided.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

16. Layout and identify ways to improve a local habitat. (Assignment Sheet #1)

17. Identify ways to improve a wetland habitat. (Assignment Sheet #2)

18. Determine the carrying capacity of a pond. (Assignment Sheet #3)

19. Determine the carrying capacity of rangeland. (Assignment Sheet #4)

WILDLIFE HABITATS
UNIT VI

ANSWERS TO TEST

1. a. 22
   b. 20
   c. 17
   d. 5
   e. 11
   f. 1
   g. 21
   h. 14
   i. 13
   j. 2
   k. 18
   l. 19
   m. 16
   n. 7
   o. 10

2. a. 2
   b. 4
   c. 3
   d. 1

3. Either one of the following:

   a. To maintain a quality habitat as it exists in a natural ecosystem.
   b. To improve a habitat where it has deteriorated or where a specific habitat component is lacking.

4. a. T
   b. F
   c. T
   d. T
   e. F
   f. F
   g. F
   h. F

5. a. 2 or 5
   b. 1
   c. 9
   d. 4
   e. 7
   f. 6
   g. 3

6. a. W
   b. W
   c. C
   d. C
   e. F
   f. F
   g. C
   h. W
   i. C
   j. W

7. Any four of the following:

   a. Overgrazing
   b. Mining
   c. Recreational activities
   d. Construction
   e. Logging
   f. Roads
   g. Chemicals

ANSWERS TO TEST

8. a. 1
   b. 6
   c. 7
   d. 4
   e. 5
   f. 3

9. a. Deep
   b. Shallow
   c. 1) Livestock
      2) Watershed
      3) Basin
      4) Shallow

10. a. F
    b. T
    c. T
    d. T
    e. F
    f. F
    g. T

11. a. Increase
    b. More
    c. Much
    d. 50

12. a. Preferred
    b. Snags
    c. Openings
    d. 1) Avoided
       2) Piled near edge

13. a. T
    b. F
    c. T
    d. F
    e. F
    f. T

14. a. F
    b. F
    c. T
    d. F
    e. F

15. a. T
    b. F
    c. T

16.-19. Evaluated to the satisfaction of the instructor.

OUTDOOR RECREATION
UNIT VII

UNIT OBJECTIVE

After completion of this unit, the student should be able to list the equipment, facilities, skills, and licenses required for various outdoor recreation activities, evaluate a local outdoor recreation site, plan and design a new outdoor recreation area, and research local employment opportunities in outdoor recreation. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to outdoor recreation with the correct definitions.
2. List equipment and facilities needed for outdoor recreation activities.
3. State the skills and licenses needed for outdoor recreation activities.
4. Select from a list the major factors increasing the demand and participation in outdoor recreation.
5. Select true statements concerning other factors affecting current and future participation in recreation activities.
6. List considerations people use in selecting an outdoor recreation area.
7. List motivations for Americans to participate in outdoor recreation.
8. List agencies responsible for public lands, recreation areas, and employment in outdoor recreation.
9. List employment opportunities in outdoor recreation.
10. List business opportunities in outdoor recreation.
11. Identify outdoor recreation activities and facilities available locally. (Assignment Sheet #1)
12. Make a presentation about outdoor recreation. (Assignment Sheet #2)
13. Interpret graphs on future trends in outdoor recreation. (Assignment Sheet #3)
14. Evaluate a local outdoor recreation site. (Assignment Sheet #4)
15. Plan and design a new outdoor recreation area. (Assignment Sheet #5)
16. Research local employment opportunities in outdoor recreation. (Assignment Sheet #6)

OUTDOOR RECREATION
UNIT VII

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher book only and are designed to be used with the following objectives:

- TMs 1-3 — Why Do People Enjoy These Activities? — Objective 7
- TM 4 — Career Opportunities in Outdoor Recreation — Objective 9

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. You may want students to work in teams for the assignment sheets.
2. Invite guest speakers to discuss with the class their occupations, skills and education required, and possibly demonstrate a specific skill or safety procedure associated with their occupations. Choose from the following as time allows:
    - Park ranger
    - Lake ranger
    - Game warden
    - Entertainment manager
    - Outdoor guide
    - Fish farmer
    - Campground owner
    - Qualified life guard
    - Instructor
    - First aid or safety expert
    - Recreation manager
    - Business owner
    - Banker
    - Owner of bait shop
    - Youth camp owner/operator
    - Owner of a riding stable

SUGGESTED ACTIVITIES

3. Videotape the students giving oral presentations in Assignment Sheet #2. Students should view these so they can work on improving their speaking and presentation skills.

4. Display safety posters (commercially made or those made by students) which deal with outdoor recreations such as boating, hunting, skiing, camping, etc.

5. Visit a large park or recreation area, and tour the facility with a park manager, ranger, or park employee. You might want to tie this in with Assignment Sheet #4.

6. After students complete Assignment Sheet #4, contact the appropriate facility manager and discuss the students' findings and any improvements that would be appropriate.

7. If facilities are available, teach students to:

    a. Saddle and care for a horse

    b. Paddle a canoe

    c. Set up a camp site

    d. Prepare for a hiking trip

    e. Use a compass — "Orienteering"

    f. Maintain grounds with power mower, string trimmer, farm tractor, and brush hog

    g. Clean up a park area and facilities

8. Have students "adopt" a local park as a class or student organization, and have them assist in making improvements.

9. Have students write a state tourism and recreation department for brochures, maps, and recreational opportunities in that state. Addresses can be found in most road atlases.

10. After students complete Assignment Sheet #6, have them work in groups and conduct additional research on one local employer. Have them determine their number of seasonal, full-time, and part-time employees, as well as the education and skills required or preferred for employment.

11. Discuss the characteristics that employers are looking for in good employees.

12. Have students interested in outdoor recreation jobs fill out employment applications.

13. Discuss ways to advance in an outdoor recreation occupation. For example, with experience, an enforcement aid may advance to be an enforcement technician. With additional experience and education, an enforcement technician may become a park ranger. Discuss other examples.

SUGGESTED ACTIVITIES

14. Use Transparency Masters 1, 2, and 3 to lead class discussion on people's motivation for outdoor recreation, or you may want to make copies and have students discuss these in writing as an assignment.

15. Students may wish to have a special project on outdoor recreation to qualify for an FFA Outdoor Recreation Proficiency Award. Refer to the FFA *Agricultural Proficiency Award Handbook* for more details.

16. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. *Report and Recommendations to the President of The United States* — President's Commission on American Outdoors. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, December 1986.

B. Van Horne, Merl J. U.S. Department of the Interior, National Park Service. *1982-1983 Nationwide Recreational Survey*. Washington, D.C.: U.S. Government Printing Office.

C. Wilcox, A.T. U.S. Department of Interior, National Park Service, *Design for Maintenance*. Washington, D.C.: U.S. Government Printing Office, 1983.

D. The President's Commission on American Outdoors, *Working Papers*. Washington, D.C.: U.S. Government Printing Office, 1987.

E. U.S. Department of the Interior, National Park Service. *Management Policies*. Washington, D.C.: U.S. Government Printing Office, 1989.

F. U.S. Department of the Interior, National Park Service. *Interpretation for Disabled Visitors in the National Park System*. Washington, D.C.: U.S. Government Printing Office, 1984.

G. Jensen, Clayne R. *Outdoor Recreation in America*. Minneapolis: Burgess Publishing Company, 1973.

H. Smith, Clodus R. *Rural Recreation for Profit*. The Interstate Printers and Publishers, Inc., 1968.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Guides and maps of the national park system are available from:

National Park Service
P.O. Box 37127
Washington, D.C. 20013-7127

B. Films, videotapes, and filmstrips

1. *Yosemite National Park*, 68-frame filmstrip and cassette or 14-minute video

2. *Lassen Volcanic National Park*, 72-frame filmstrip and cassette or 13-minute video

   Explores two of the national parks and emphasizes the science which can be studied in them.

   1 and 2 are available from:

   International Film Bureau Inc.
   332 South Michigan Avenue
   Chicago, IL 60604-4382
   312/427-4545

3. *Let No Man Regret* — 11 min. 16mm film or ½" VHS videotape. Discusses personal responsibility to preserve the natural beauty of our recreational areas. This is available from:

   Alfred Higgins Productions, Inc.
   9100 Sunset Boulevard
   Los Angeles, CA 90069-9990
   213/272-6500

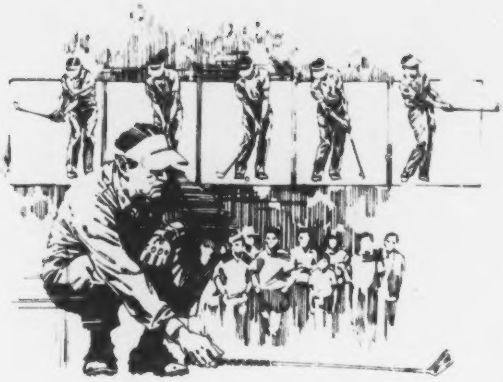
4. *A Question of Quality*, 010668/PY — 29 min. 16mm or ½", ¾" or Beta videotape. 1977. Developed by U.S. Department of Interior, National Park Service. Deals with protecting forests and wildernesses while still allowing visitors to enjoy them.

5. *New Life for Ruined Land*, A08996/PY — 14 min. 16mm or ½", ¾" or Beta videotape. 1979. Developed by Department of Energy. Describes Department of Energy's Land Reclamation Program to convert an abandoned coal mining site in Southern Illinois into a wildlife refuge and recreational facility.

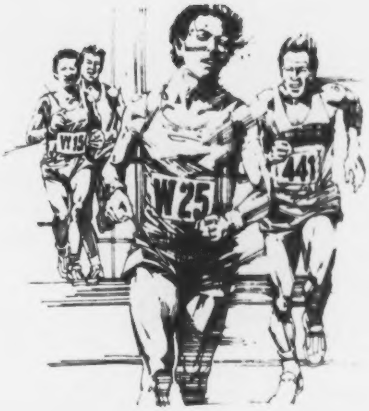
   4 and 5 are available from:

   National Audiovisual Center
   National Archives and Records Administration
   Customer Service Section PY
   8700 Edgeworth Drive
   Capitol Heights, MD 20743-3701
   301/763-1896

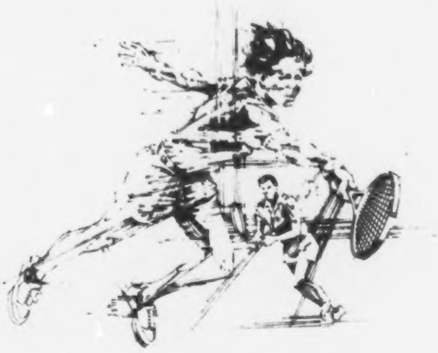
Why Do People Enjoy These Activities?



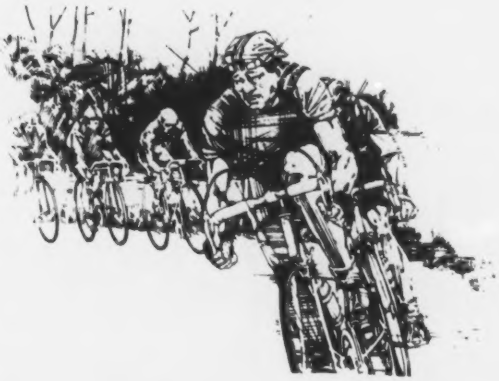
Golfing ________________



Jogging/Walking ________________

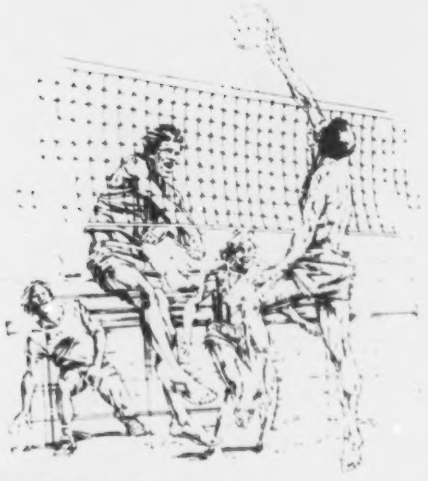


Tennis ________________

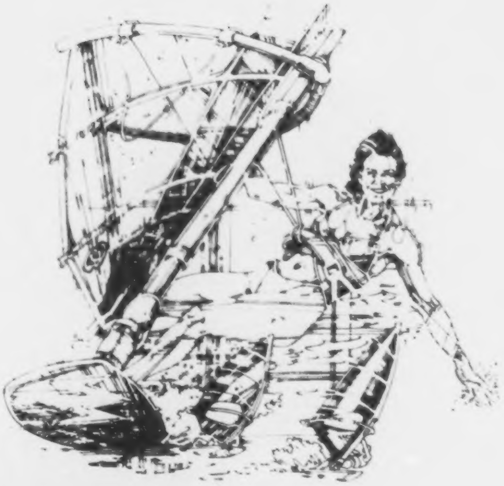


Biking ________________

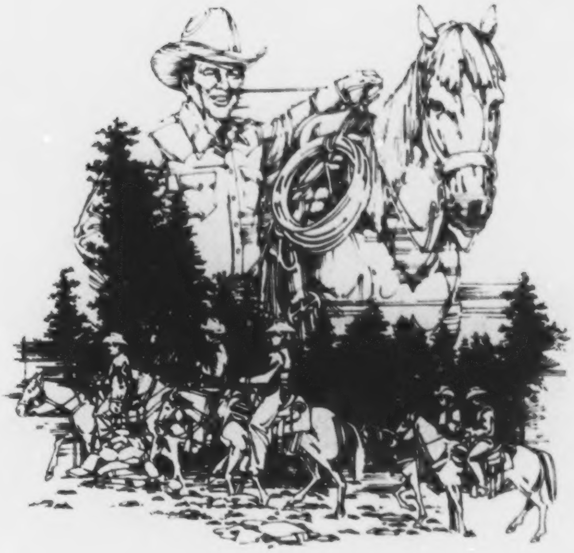
Why Do People Enjoy These Activities?



Volleyball ____________________



Boating/Surfing ____________________

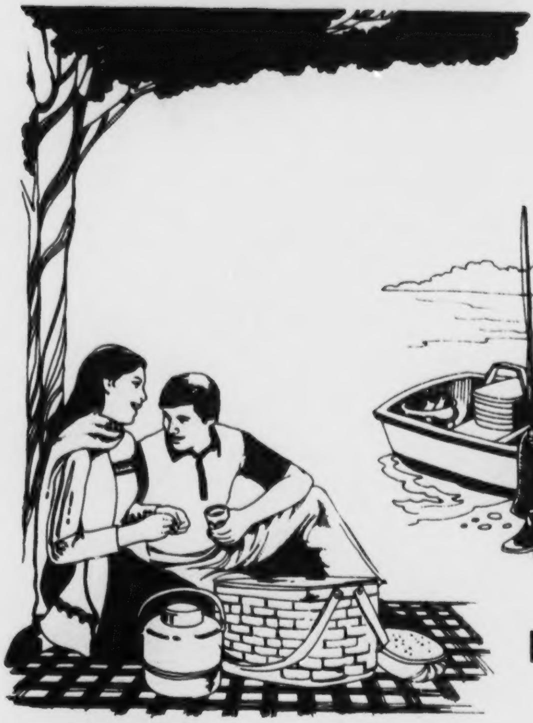


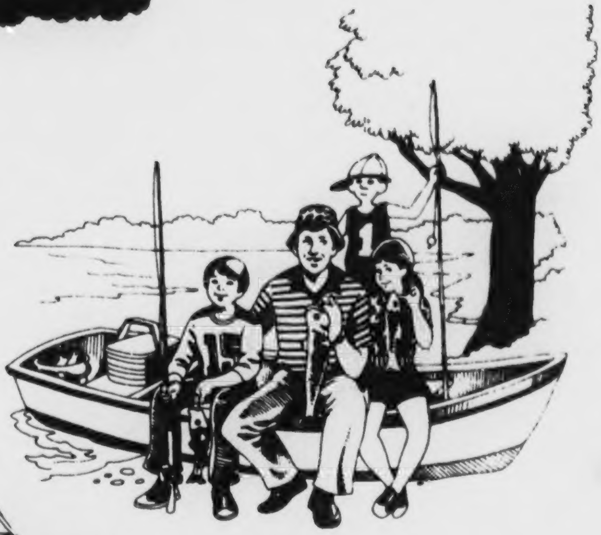
Horseback Riding

____

TM 2

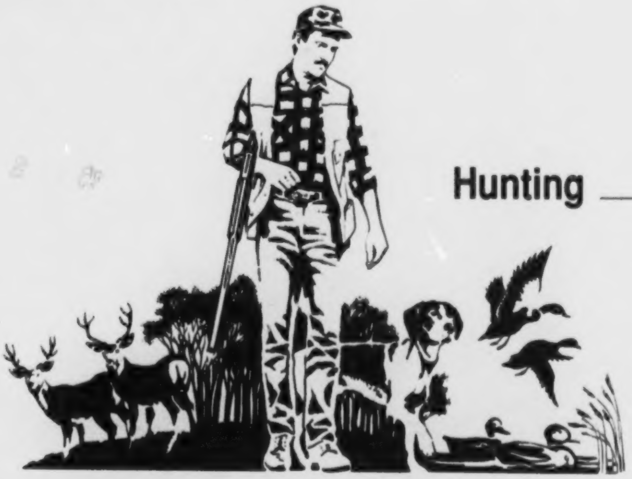
Why Do People Enjoy These Activities?





Fishing ________________

Picnicking ________________



Hunting ________________

TM 3

Career Opportunities in Outdoor Recreation

	Business Management	Entertainment	Enforcement	Equipment Operation	Ground Care	Guide Service or Inst.	Recreation Management	Rental	Safety	Sanitation
Biking	X			X	X			X	X	
Boating	X	X	X	X		X	X	X	X	X
Camping	X	X	X	X	X	X	X	X	X	X
Canoeing	X	X	X	X		X	X	X	X	
City Parks	X	X	X		X		X		X	X
Fishing	X		X	X		X		X	X	
Four Wheeling	X		X	X	X			X	X	
Golfing	X				X	X	X	X	X	
Hang Gliding	X		X	X		X	X		X	
Hiking					X	X		X	X	
Horseback riding	X				X	X	X	X	X	
Hunting	X		X	X		X			X	
Jogging/Walking						X			X	
Lawn Games					X			X	X	
Picnicking		X			X				X	X
Scuba Diving	X		X	X		X	X	X	X	
Sight Seeing	X	X			X	X	X		X	
Snow Skiing	X		X	X	X	X	X	X	X	
Surfing	X			X		X		X	X	
Swimming	X				X	X	X		X	X
Tennis	X			X	X	X			X	
Water Skiing	X		X	X	X	X	X	X	X	

OUTDOOR RECREATION
UNIT VII

INFORMATION SHEET

I. Terms and definitions

A. Concessions — The right to sell food, supplies, or equipment at a park or event

B. Convenience — Something that makes work easier

C. Cultural event — Events or programs which train and refine the mind

D. Demand — The desire for something, together with the ability to pay for it

E. Disposable personal income (DPI) — Income above what is needed to buy life's necessities

F. Facility — A structure or convenience which allows something to be done more easily or enjoyably

G. Leisure — Unoccupied time during which one may indulge in rest or recreation

H. Life expectancy — The average age at which people die

I. Motivation — An inner drive (need or desire) that causes one to act in a certain way

J. Recreation — Refreshing and restoring a person's strength and spirit after work

K. Rest — Free from work or activity

L. Scenic — View or landscaping having natural beauty

M. Statistics — Facts of a numerical kind

N. Stress — Tension, strain, or force exerted upon a body

O. Terrain — Tract of ground, especially in regard to its features or fitness for some use

P. Trend — The general tendency of a course of events

Q. Unique — One of a kind or distinctive

INFORMATION SHEET

II. **Equipment and facilities needed for outdoor recreation activities** (Assignment Sheets #1 and #2)

Activity	Equipment	Facility Requirements
Biking	Bicycle, helmet	Bike trails, safety signs
Bird watching	Binoculars, camera, bird books	Natural habitats for birds
Boating	Motor or sail boat	Lake or large river
Camping	Tent or trailer, cookware, lights, proper clothing	Table, grill, trash disposal, clean, scenic uncrowded area
Canoeing	Canoe, life jacket, paddles	Stream or lake
Fishing	Fishing pole, reel, bait	Lake, stream, or farm pond
Four wheeling-ATV	Four wheel drive vehicle or other all-terrain vehicle	Rough or challenging terrain, dry stream beds
Golfing	Golf equipment	Golf course, driving range, or miniature golf course
Hang gliding	Hang glider	Steep terrain, dependable air currents
Hiking	Shoes, pack, food, maps	Hiking trails, scenic area
Horseback riding	Horse, riding gear (tack)	Barns, corrals, riding area
Hunting	Gun, ammunition, proper clothing	Private hunting area with permission or public hunting area
Jogging/walking	Proper shoes and clothing	Trails or tracks
Lawn games such as volleyball, badminton	Game equipment	Small open, uncrowded areas
Picnicking	Food, table	Shaded, scenic area, clean, free of pests
Scuba diving	Diving equipment, boat	Clear lake, ocean or stream
Sight seeing	Private vehicle or bus	Scenic turn-outs, information signs
Snow skiing	Skies, boots, proper clothing	Mountainous area, heavy snowfall
Surfing	Surfboard or sailboard	Coastal areas or lakes
Swimming	Life vest, "buddy"	Indoor or outdoor swimming area
Tennis	Tennis racquet, balls, shoes	Tennis court
Water skiing	Skies, boat, ski rope, life vest	Lake or large river

INFORMATION SHEET

III. **Skills and licenses needed for outdoor recreation activities** (Assignment Sheets #1 and #2)

Activity	Skills	License/ Permit/Certification
Biking	Biking techniques, safety	Bike license required in some states
Bird watching	Knowledge of species and habitats	None
Boating	Boat operation, safety	Boat, motor, trailer license
Camping	Tent pitching, fire building	Permits at some locations
Canoeing	Paddling, safety	Canoe license in some states
Fishing	Technique	Fishing license or permit
Four wheeling-ATV	Performance capability, safety	License required in some states
Golfing	Technique	Usually a fee is required
Hang gliding	Coordination, safety	Certification from hang gliding school
Hiking	Map reading, physical fitness	None
Horseback riding	Saddling, caring for a horse, safety	None
Hunting	Knowledge of the outdoors, safety	Hunting license
Jogging/walking	None	None
Lawn games	Various techniques	None
Picnicking	None	None
Scuba diving	Swimming, safety	Scuba diving certificate
Sightseeing	Map reading	None
Snow skiing	Balance, technique, endurance, safety	None, a fee may be required
Surfing	Balance, safety	None
Swimming	Swimming technique, safety	None, a fee may be required
Tennis	Balance, technique, endurance	None
Water skiing	Balance, technique, safety	None

INFORMATION SHEET

IV. **Major factors increasing the demand and participation in outdoor recreation**

A. **Leisure time** — As leisure time increases, participation in outdoor recreation increases.

B. **Income** — As individual income increases, the ability to pay for outdoor recreational equipment, area-use fees, transportation, and facility fees also increases.

C. **Mobility** — The ability of an individual to travel freely influences the participation in outdoor recreational activities. The automobile, available to most Americans, is the principal means of transportation to recreational destinations.

V. **Other factors affecting current and future participation in recreation activities** (Assignment Sheet #3)

A. **Age** — More Americans are retiring at an earlier age. Less than 1 in 4 wait until age 65 to retire.

- Life expectancy is increasing because of better health care and environmental conditions.
- Early retirement and increased life expectancy increases leisure time for senior citizens resulting in a greater demand for outdoor recreation facilities.

B. **Disposable personal income (DPI)** — Has increased in the past 20 years.

(NOTE: In 1988 the share of DPI going to recreation was 6.4%.)

C. **Physical disability** — 56% of people with physical disabilities are limited by mobility which prevents their participation in outdoor recreation. As accommodations for the handicapped improve, participation in outdoor recreation will follow.

D. **Women** — As more women join the work force, advance toward economic equity, and have more leisure time, they will be more active in outdoor recreation and will likely become leaders in recreation activity trends.

VI. **Considerations people use in selecting an outdoor recreation area.** (Assignment Sheet #4)

(NOTE: These are listed in rank order.)

A. Natural beauty (An area with outstanding scenic qualities)

B. Amount of crowding

(NOTE: Many people travel to recreational areas to get away from crowds.)

INFORMATION SHEET

C. Sanitation facilities (clean and convenient)

D. Parking availability

E. Available information (information centers, brochures, signs)

F. Picnic areas (clean and convenient)

G. Cultural events

H. User fees

(NOTE: Fees are used primarily to improve facilities, but can be instrumental in reducing overcrowding)

I. Concessions

J. Organized sports or competitive events

K. Guided activities

VII. **Motivations for Americans to participate in outdoor recreation** (Assignment Sheet #5)

(NOTE: These are grouped to show percentage of composition.)

A.	Fitness	10%

- To obtain or maintain good health from physical exercise
- To enjoy fresh air and sunshine
- To reduce stress
- To loose weight

B.	Social	33%

- For relaxation with other people
- To be with friends
- To make friends
- So the family can be together
- To have fun

C.	Excitement	16%

- To break the monotony of daily routines
- For competition in outdoor recreation activities
- For excitement in doing unusual things
- To experience the risk and danger involved
- To develop new skills

D. Experience self and nature 33%

- To be alone
- To experience nature
- To view the scenery
- To test self endurance, limitations, and character
- To watch wildlife

E. Conformist 8%

- Because everyone else is doing it
- To get away from a cramped environment

VIII. **Agencies responsible for public lands, recreation areas, and employment in outdoor recreation** (Assignment Sheet #6)

A. U.S. National Park Service

B. U.S. Forest Service

C. U.S. Corps of Engineers

D. U.S. Bureau of Reclamation

E. U.S. Bureau of Land Management

F. U.S. Fish and Wildlife Service

G. State park services

H. State recreation and tourism departments

I. State fish and game departments

J. Regional, county, and city parks

K. Private recreational areas

L. Private recreational businesses

IX. **Employment opportunities in outdoor recreation**

A. Business management — Managing a business

B. Entertainment — As applied to outdoor recreation, this would be in the form of nature programs, outdoor plays, or musical entertainment

C. Enforcement — As a park ranger, lake ranger, or game warden

D. Equipment operation — Truck drivers or operators of tractors, chain saws, lawn mowers, string trimmers, water pumps, and electric motors

INFORMATION SHEET

E. Ground care — Landscaping, grass trimming, camp site cleaning, and facility repair

F. Guide service — Hunting or fishing guide, hiking guide, canoeing and rafting, horseback riding, sight seeing

G. Instruction — Golf, hang gliding, scuba diving, surfing, wind surfing, swimming, tennis, snow and water skiing

H. Recreation management — Managing a recreational area or activity

I. Rental — Paying for the use of recreational equipment

J. Safety — The instruction of safety procedures or first aid

K. Sanitation — Maintaining the sanitary facilities such as garbage, restrooms, pest control, trailer dump facilities, and general cleanliness

X. Business opportunities in outdoor recreation

A. Contractual

  1. Grounds care
  2. Landscaping
  3. Sanitation

B. Bait shop

C. Dude ranch

D. Equipment maintenance

E. Equipment sales

F. Fish farms

G. Guide service

  1. Hunting
  2. Fishing
  3. Hiking
  4. Canoeing/rafting
  5. Horseback riding/pack train
  6. Scuba diving
  7. Sight seeing

INFORMATION SHEET

H. Hunting preserve

I. Instruction and sales

J. Excursion boat

K. R.V. campground

L. Equipment rental

M. Sporting goods store

N. Travel agent

O. Youth camp

OUTDOOR RECREATION
UNIT VII

ASSIGNMENT SHEET #1 — IDENTIFY OUTDOOR RECREATION ACTIVITIES AND FACILITIES AVAILABLE LOCALLY

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Ten local outdoor recreation areas are listed	______
Facilities are correct for each	______
Questions are answered appropriately	______

Directions: List ten (10) outdoor recreational activities that are available to you within thirty miles of your home. Also describe the facilities available for each. Then answer the questions that follow.

Local Outdoor Recreational Activities	Facilities Available
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

ASSIGNMENT SHEET #1

Questions:

1. Of the outdoor recreational activities listed above, which ones do you participate in? ______________________________

2. How often do you participate in them? ______________________________

3. What outdoor recreations do you think you would like, but you have never tried? ______________________________

4. What outdoor recreations are not available locally? ______________________________

5. Are there any outdoor recreations that are available locally, but that are too crowded or too expensive for you? ______________________________

OUTDOOR RECREATION
UNIT VII

ASSIGNMENT SHEET #2 — MAKE A PRESENTATION ABOUT OUTDOOR RECREATION

NAME ______________________________ SCORE __________

EVALUATION CRITERIA	
Criteria	Rating
Presentation was:	
• Well planned	_____
• Informative	_____
• Interesting	_____
Correct length	_____
Overall quality	_____

Directions: Choose an outdoor recreation activity and then prepare a 5-10 minute presentation on your activity. The presentation may be one of the following:

- Oral presentation to class/instructor with at least one visual aid such as tools or equipment used for activity, slides about activity, poster of safety rules, etc.
- Videotape presentation about your activity

Presentation Suggestions

1. Proper use of the special equipment needed for a particular outdoor recreation.
2. Safety demonstration for a particular outdoor recreation.
3. First aid demonstration.
4. Your favorite outdoor recreational activity, why you like it, and what skills and equipment are involved.

OUTDOOR RECREATION
UNIT VII

ASSIGNMENT SHEET #3 — INTERPRET GRAPHS ON FUTURE TRENDS IN OUTDOOR RECREATION

NAME ________________________________ SCORE __________

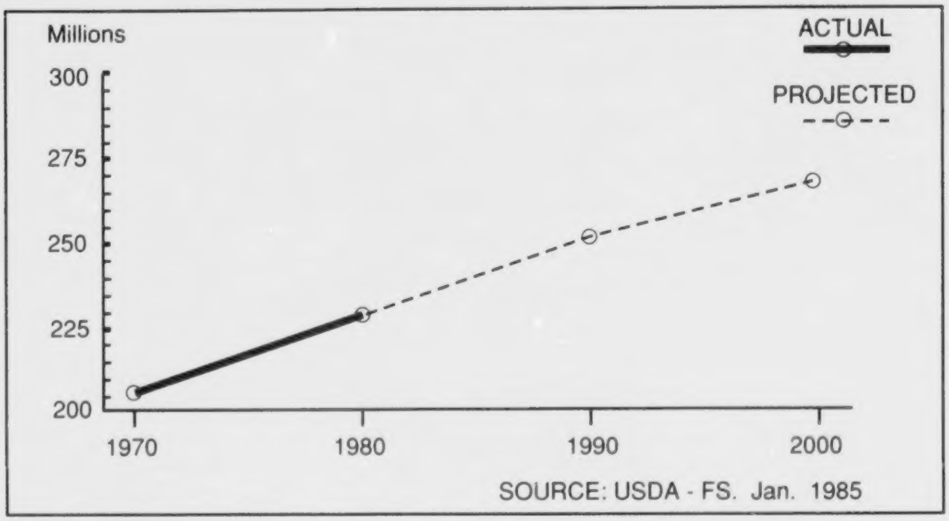
EVALUATION CRITERIA	
Criteria	Rating
Answers are correct	______

Directions: Using the graphs on the following pages (Tables 1-5), answer these questions.

1. What will the population of the United States be in 1990? ______________
2. What will the population of the United States be in the year 2000? ______________
3. What will the population growth be between 1990 and 2000? ______________
4. Considering that 90% of people participate in outdoor recreation, how many more people will participate in 2000 vs 1990? ______________
5. What was the percent participation of family members in 1985? ______________
6. What was the percentage of people age 12-19 who visited federal and state parks in 1985? ______________
7. What percentage of people over 60 visit federal and state recreational areas? ______________
8. What was the percentage of disabled visitors to public recreation areas in the United States in 1985? ______________
9. What was the fastest growing recreational activity in the United States between 1960 and 1982? ______________
10. What was the percentage of increase in the recreational activity in question 9? ______________

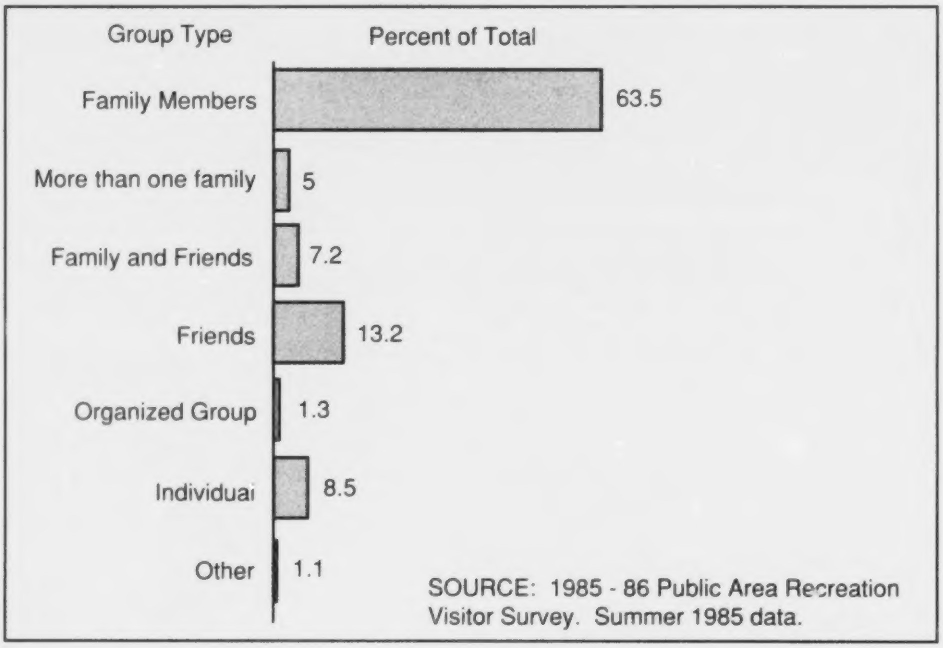
ASSIGNMENT SHEET #3

TABLE 1 — U.S. POPULATION FROM 1970 TO 1980 WITH PROJECTIONS TO 2000



SOURCE: USDA - FS. Jan. 1985

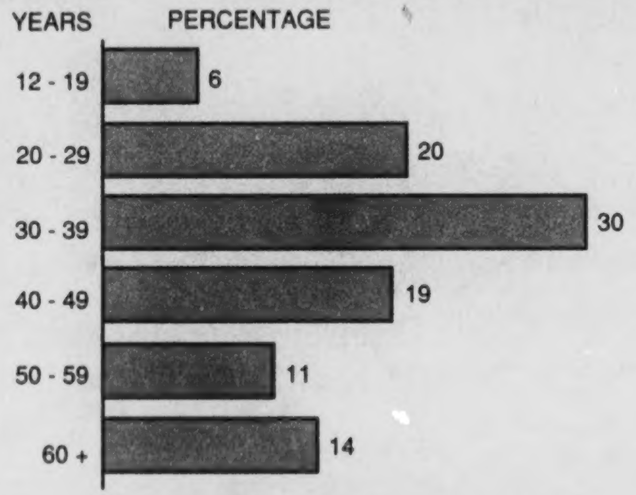
TABLE 2 — GROUP COMPOSITION OF VISITORS TO PUBLIC RECREATION AREAS IN THE U.S., 1985



SOURCE: 1985 - 86 Public Area Recreation Visitor Survey. Summer 1985 data.

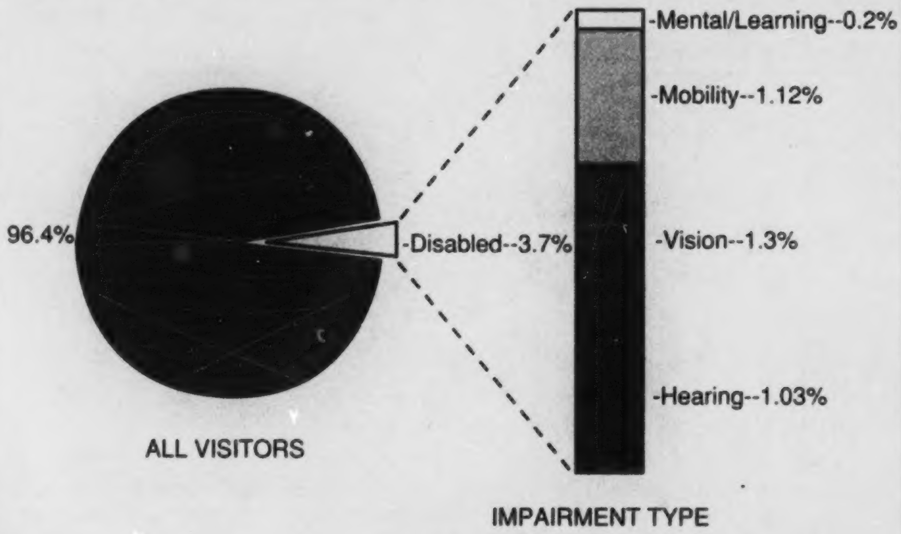
ASSIGNMENT SHEET #3

TABLE 3 — PROFILE OF VISITORS TO FEDERAL AND STATE AREAS IN THE UNITED STATES, SUMMER 1985, ACCORDING TO AGE (only persons 12 +)



SOURCE: Public Area Recreation Visitor Survey Summer 1985 data.

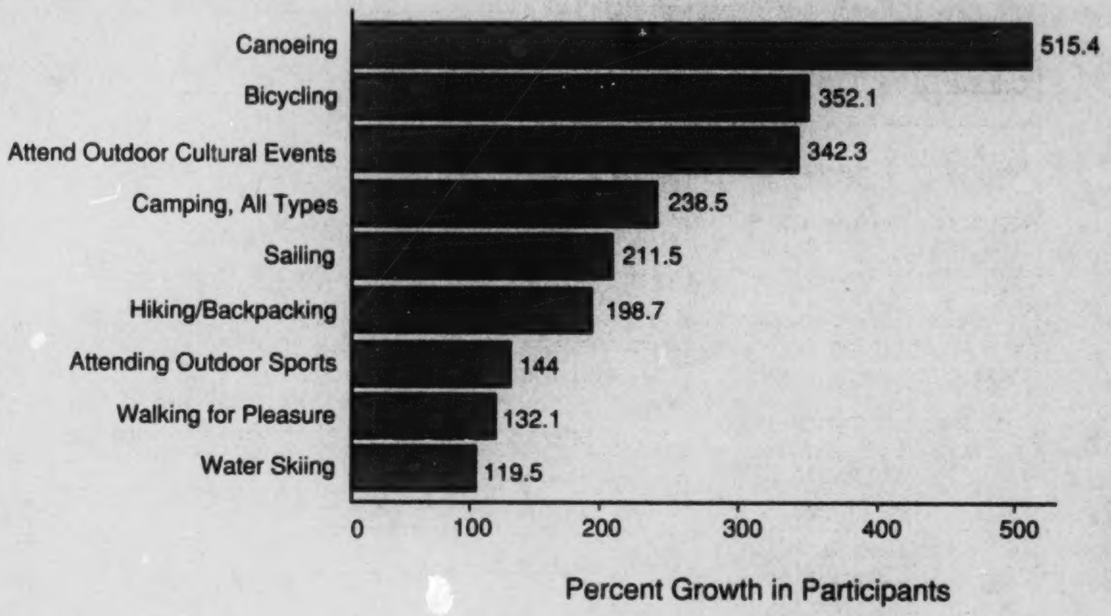
TABLE 4 — DISABLED VISITORS TO PUBLIC RECREATION AREAS IN THE UNITED STATES, 1985



SOURCE: Public Area Recreation Visitor Survey. Summer 1985 data.

ASSIGNMENT SHEET #3

TABLE 5 — PERCENTAGE CHANGES IN NUMBER OF SUMMER PARTICIPANTS IN NINE RAPIDLY GROWING ACTIVITIES, 1960-1982



SOURCE: 1960, 1982-83 National Recreation Survey.

OUTDOOR RECREATION
UNIT VII

ASSIGNMENT SHEET #4 — EVALUATE A LOCAL OUTDOOR RECREATION SITE

NAME ________________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Evaluation is accurate	______
Recommendations are appropriate	______

Directions: Visit a local park or recreational site. Survey the area and its facilities. Rate the site according to the following criteria. Then make recommendations on ways to improve the site.

	Excellent	Acceptable	Unacceptable	Not present
1. Natural beauty				
2. Amount of crowding				
3. Sanitation facilities				
4. Parking availability				
5. Available information				
6. Picnic areas				
7. Cultural events				
8. User fees				
9. Concessions				
10. Organized sports				
11. Guided activities				
12. Others (list as needed)				
______				
______				

Recommendations for improvement of site: (use back of page if needed)

1. ________________________________

2. ________________________________

3. ________________________________

4 ________________________________

5. ________________________________

OUTDOOR RECREATION
UNIT VII

ASSIGNMENT SHEET #5 — PLAN AND DESIGN A NEW OUTDOOR RECREATION AREA

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Well presented and neat	______
Well described	______
Practical and useful ideas	______
Area would be enjoyable	______

Directions: Consider yourself a park manager. You are developing a new area for camping. It is your responsibility to plan and design the area for maximum convenience, comfort, and enjoyment. You may want to use drawings or pictures to show your design. Most of all, use your imagination.

Review the information sheet to determine the facilities and equipment needed for camping. Also, analyze what people want in a camping area, and why they enjoy camping. Also, try to make your area accessible for the handicapped.

OUTDOOR RECREATION
UNIT VII

ASSIGNMENT SHEET #6 — RESEARCH LOCAL EMPLOYMENT OPPORTUNITIES IN OUTDOOR RECREATION

NAME ______________________________ SCORE __________

EVALUATION CRITERIA	
Criteria	Rating
Employers listed are appropriate	______

Directions: Make a list below of government agencies, organizations, or businesses that employ people in outdoor recreation. Refer to local telephone and business directories for help.

Potential Employers	Addresses
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

OUTDOOR RECREATION
UNIT VII

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheets #1 and #2 — Evaluated according to the stated criteria

Assignment Sheet #3

1. 250,000,000
2. 270,000,000
3. 20,000,000
4. 18,000,000
5. 63.5
6. 6
7. 14
8. 3.7
9. Canoeing
10. 514.4

Assignment Sheets #4-#6 — Evaluated according to the stated criteria

OUTDOOR RECREATION
UNIT VII

TEST

NAME ____________________ SCORE __________

1. Match the terms on the right with the correct definitions.

______a. Refreshing and restoring a person's strength and spirit after work

______b. A structure or convenience which allows something to be done more easily or enjoyably

______c. View or landscape having natural beauty

______d. Tract of ground, especially in regard to its features or fitness for some use

______e. Free from work or activity

______f. The general tendency of a course of events

______g. Unoccupied time during which one may indulge in rest or recreation

______h. One of a kind or distinctive

______i. The right to sell food, supplies, or equipment at a park or event

______j. An inner drive (need or desire) that causes one to act in a certain way

1. Concessions
2. Convenience
3. Cultural events
4. Demand
5. Facility
6. Leisure
7. Motivation
8. Recreation
9. Rest
10. Scenic
11. Statistics
12. Stress
13. Terrain
14. Trend
15. Unique

2. List four outdoor recreation activities and the equipment and facilities needed for each.

Activity	Equipment	Facility
a. ______		
b. ______		
c. ______		
d. ______		

TEST

3. State skills and licenses required for the following outdoor recreation activities.

Activity	What special skills are needed?
a. Hunting	
b. Swimming	
c. Horseback riding	
d. Biking	

Activity	Is license or permit needed? (Yes or No)
e. Fishing	
f. Surfing	
g. Boating	
h. Hunting	
i. Jogging	

4. Select from the following list the major factors increasing the demand and participation in outdoor recreation by placing an "X" next to the correct factors.

______a. More leisure time increases participation.

______b. More income increases participation.

______c. Larger families increases participation.

______d. Larger workloads (more work) increases participation.

______e. Greater mobility (easier travel) increases participation.

5. Select true statements concerning other factors affecting current and future participation in recreational activities by placing a "T" or "F" next to the true or false statements.

______a. More Americans are retiring at a later age (over 70) which increases leisure time for outdoor recreation.

______b. Disposable personal income has decreased in the past year, so people have less money for outdoor recreation.

______c. As accommodations for the handicapped improve, their participation in outdoor recreation will increase.

TEST

6. List five considerations people use in selecting an outdoor recreation area.

a. ______

b. ______

c. ______

d. ______

e. ______

7. List three basic motivations for Americans to participate in outdoor recreation.

a. ______

b. ______

c. ______

8. List four agencies responsible for public lands, recreation areas, and employment in outdoor recreation.

a. ______

b. ______

c. ______

d. ______

9. List seven employment opportunities in outdoor recreation.

a. ______

b. ______

c. ______

d. ______

e. ______

f. ______

g. ______

TEST

10. List eight business opportunities in outdoor recreation.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

    e. ______________________________

    f. ______________________________

    g. ______________________________

    h. ______________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Identify outdoor recreation activities and facilities available locally. (Assignment Sheet #1)

12. Make a presentation about outdoor recreation. (Assignment Sheet #2)

13. Interpret graphs on future trends in outdoor recreation. (Assignment Sheet #3)

14. Evaluate a local outdoor recreation site. (Assignment Sheet #4)

15. Plan and design a new outdoor recreation area. (Assignment Sheet #5)

16. Research local employment opportunities in outdoor recreation. (Assignment Sheet #6)

OUTDOOR RECREATION
UNIT VII

ANSWERS TO TEST

1. a. 8
   b. 5
   c. 10
   d. 13
   e. 9
   f. 14
   g. 6
   h. 15
   i. 1
   j. 7

2. Any four of the following:

Activity	Equipment	Facility
Biking	Bicycle, helmet	Bike trails, safety signs
Bird watching	Binoculars, camera, bird books	Natural habitats for birds
Boating	Motor or sail boat	Lake or large river
Camping	Tent or trailer, cookware, lights, proper clothing	Table, grill, trash disposal, clean, scenic uncrowded area
Canoeing	Canoe, life jacket, paddles	Stream or lake
Fishing	Fishing pole, reel, bait	Lake, stream, or farm pond
Four wheeling-ATV	Four wheel drive vehicle or other all-terrain vehicle	Rough or challenging terrain, dry stream beds
Golfing	Golf equipment	Golf course, driving range, or miniature golf course
Hang gliding	Hang glider	Steep terrain, dependable air currents
Hiking	Shoes, pack, food, maps	Hiking trails, scenic area
Horseback riding	Horse, riding gear (tack)	Barns, corrals, riding area
Hunting	Gun, ammunition, proper clothing	Private hunting area with permission or public hunting area
Jogging/walking	Proper shoes and clothing	Trails or tracks
Lawn games such as volleyball, badminton	Game equipment	Small open, uncrowded areas
Picnicking	Food, table	Shaded, scenic area, clean, free of pests
Scuba diving	Diving equipment, boat	Clear lake, ocean or stream
Sight seeing	Private vehicle or bus	Scenic turn-outs, information signs
Snow skiing	Skies, boots, proper clothing	Mountainous area, heavy snowfall
Surfing	Surfboard or sailboard	Coastal areas or lakes
Swimming	Life vest, "buddy"	Indoor or outdoor swimming area
Tennis	Tennis racquet, balls, shoes	Tennis court
Water skiing	Skies, boat, ski rope, life vest	Lake or large river

ANSWERS TO TEST

3. a. Knowledge of the outdoors, safety
   b. Swimming technique, safety
   c. Saddling, caring for a horse, safety
   d. Biking technique, safety
   e. Yes
   f. No
   g. Yes
   h. Yes
   i. No

4. a, b, e

5. a F
   b. F
   c. T

6. Any five of the following:

   a. Natural beauty
   b. Amount of crowding
   c. Sanitation facilities
   d. Parking availability
   e. Available information
   f. Picnic areas
   g. Cultural events
   h. User fees
   i. Concessions
   j. Organized sports
   k. Guided activities

7. Any three of the following:

   a. Fitness
   b. Social
   c. Excitement
   d. Experience self and nature
   e. Conformist

8. Any four of the following:

   a. U.S. National Park Service
   b. U.S. Forest Service
   c. U.S. Corps of Engineers
   d. U.S. Bureau of Reclamation
   e. U.S. Bureau of Land Management
   f. U.S. Fish and Wildlife Service
   g. State park services
   h. State recreation and tourism departments
   i. State fish and game departments
   j. Regional, county, and city parks
   k. Private recreational areas
   l. Private recreational businesses

ANSWERS TO TEST

9. Any seven of the following:

    a. Business management
    b. Entertainment
    c. Enforcement
    d. Equipment operation
    e. Ground care
    f. Guide service
    g. Instruction
    h. Recreation manager
    i. Rental
    j. Safety
    k. Sanitation

10. Any eight of the following:

    a. Contractual such as grounds care, landscaping, or sanitation
    b. Bait shop
    c. Dude ranch
    d. Equipment maintenance
    e. Equipment sales
    f. Fish farms
    g. Guide service such as for hunting, fishing, hiking, etc.
    h. Hunting preserve
    i. Instruction and sales
    j. Excursion boat
    k. R.V. campground
    l. Equipment rental
    m. Sporting good store
    n. Travel agent
    o. Youth camp

11-16. Evaluated to the satisfaction of the instructor

FORESTRY
UNIT VIII

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify, classify, measure, and plant trees. Competencies will be demonstrated by completing the assignment sheets, job sheets, and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to forestry with the correct definitions.
2. Distinguish among the main parts of a tree.
3. Identify the parts of the crown.
4. Identify the parts of the trunk.
5. Distinguish among the types of roots in a root system.
6. List ways trees are identified.
7. Select true statements concerning the photosynthesis process.
8. Complete statements concerning the growth of a tree.
9. Distinguish between the classifications of trees.
10. List common uses of trees.
11. Select from a list the benefits of forests to the environment.
12. List government agencies involved in forestry.
13. Identify the major forest regions of the continental United States.
14. Match the types of forest cuttings with the correct definitions.
15. List ways that tree stands regenerate.
16. Match forest measurements with the correct descriptions.
17. Identify measuring instruments used in forestry.
18. List forest enemies.
19. Select from a list the causes of fire.

SPECIFIC OBJECTIVES

20. Match types of forest fires with the correct descriptions.
21. Distinguish between categories of forest fires.
22. List benefits of controlled burns.
23. List careers in forestry.
24. Identify specific trees. (Assignment Sheet #1)
25. Determine the age of a tree. (Assignment Sheet #2)
26. Classify local trees. (Assignment Sheet #3)
27. Determine uses of wood and wood by-products. (Assignment Sheet #4)
28. Solve cord measurement problems. (Assignment Sheet #5)
29. Demonstrate the ability to:
    a. Plant a bareroot tree. (Job Sheet #1)
    b. Measure diameter of a tree. (Job Sheet #2)
    c. Measure merchantable height of a tree. (Job Sheet #3)

FORESTRY
UNIT VIII

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher book only and are designed to be used with the following objectives:

TM 1 — Main Parts of a Tree — Objectives 2-5

TM 2 — Types of Wood — Objective 9

TM 3 — Forest Regions of the United States — Objective 13

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheets.

H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. Discuss the suitability of certain trees in various settings.
2. Start a tree farm.
3. Collect and exhibit common tree leaves as well as their flowers, seeds, or bark samples if possible.
4. Provide tree identification books so students can identify the leaves they collect. (Assignment Sheet #1)
5. Label trees in the school yard area.
6. Plan a tree identification contest.
7. Make an exhibit showing parts of a tree.
8. Cut cross sections of tree trunks so students can count their annual rings. (Assignment Sheet #2)

SUGGESTED ACTIVITIES

9. Make an exhibit showing differences between broadleafs and conifers. (Assignment Sheet #3)

10. Make an exhibit showing differences between hardwoods and softwoods. (Assignment Sheet #3)

11. Make a list of types of wood and their common uses. (Assignment Sheet #4)

12. Visit a lumber mill.

13. Make flash cards with different dimensions of wood written on them. Challenge students to figure cost of a cord.

14. Determine the local cost of a cord of wood. (Assignment Sheet #5)

15. Have students prepare a report on the history of forestry in the area.

16. Discuss any local problems occurring in nearby forests.

17. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Anderson, David A. *Forests and Forestry,* 3rd ed. Danville, IL: The Interstate Printers & Publishers, Inc., 1982.

B. Collins, B. McManus. *Elementary Forestry.* Reston, VA: Reston Publishing Company, Inc., 1981.

C. Kircher, Harry B. *Our Natural Resources and Their Conservation,* 6th ed. Danville, IL: The Interstate Printers & Publishers, Inc., 1988.

D. Camp, William G. *Managing Our Natural Resources.* Albany, NY: Delmar Publishers Inc., 1988.

E. National 4-H Council. *4-H Forestry Program,* " Unit A-Trees". Washington, D.C.: United States Department of Agriculture.

F. McClay, David R. *Occupational Preparation in the National Resources.* Washington, D.C.: U.S. Government Printing Office, 1973.

RESOURCES USED IN DEVELOPING THIS UNIT

G. Burns, Russell. *The Scientific Basic for Silvicultural and Management Decisions in the National Forest System.* USDA Forest Service, 1989.

H. *Plant a Tree for Your Special Occasion,* FS 363. USDA Forest Service.

I. *Planting and Care of Farm Forests,* VAS 4024. Urbana, IL: University of Illinois.

J. *Managing Forested Lands for Wildlife.* Developed in cooperation with USDA Forest Service, Rocky Mountain Region. Published by Colorado Division of Wildlife, 1984.

SUGGESTED SUPPLEMENTAL RESOURCES

A. *Forestry and Related Review* — Software for Apple II+, IIe, IIc and for IBM and compatibles. Covers forest management, wood uses, forestry math, planting trees, and other topics.

B. *Forest Harvesting Equipment* — 35 color slide presentation with a 12 minute cassette tape and script included. Shows modern forestry equipment and procedures.

A and B are available from:

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112
612/633-3170

C. *Forestry Supplies Inc. Catalog* — Available from:

Forestry Supplies, Inc.
205 W. Rankin Street, P.O. Box 8397
Jackson, MS 39204

D. Society of American Foresters. *Forestry Handbook.* New York, NY: The Ronald Press Co., 1961.

E. *Project Learning Tree Activity Guide.* Developed by the American Forest Foundation and the Western Regional Environmental Education Council. To obtain this activity guide, you must attend a Project Learning Tree (PLT) workshop. Contact your state conservation, natural resource, or forestry department for more information on these workshops.

F. Films and videotapes

1. *Forestry: An Overview* — 20 min., © 1987, ½" and ¾" video. Deals with controversy between clear cutting and selective cutting.
2. *Managing the Old Growth Forests* — 20 min., © 1987, ½" and ¾" video. Covers old growth ecological systems and debate over cutting them.

SUGGESTED SUPPLEMENTAL RESOURCES

1 and 2 are available from:

Centre Productions, Inc.
Distributed by Barr Films
12801 Schabarun Avenue
P.O. Box 7878
Irwindale, CA 91706-7878
818/338-7878 or 800/234-7879

3. *Replanting the Tree of Life* — 20 min., © 1987, 16 mm or video. Produced by Asterisk Productions. Discusses the essential part that trees play in our lives and in the life of the planet.

4. *Common Ground* — 29 min., © 1985, 16 mm or video. Produced by The Conservation Foundation. Examines the complex forest policy issues.

5. *Choices '85* — 29 min., © 1985, 16 mm or video. Produced by The Conservation Foundation. Discusses national forest planning and its relationship to the Forest and Rangeland Renewable and Resources Planning Act of 1975.

3-5 are available from:

BullFrog Films, Inc.
Oley, PA 19547
800/543-FROG

6. *Once the Fire Is Out...What Next?*, A06103/PY — 16 min. 1981. 16 mm film, ½", ¾", or Beta videos. Produced by the U.S. Department of Agriculture, U.S. Forest Service. Describes the Forest Service's role in managing national forest watersheds in the aftermath of wildfire. Award winner.

7. *Trees and People Need Each Other*, A09989/PY — 26 min. 1980. 16 mm films, ½", ¾", or Beta videos. Sponsored by U.S. Department of Agriculture. Explores ways a community can establish and maintain its urban forest. Award winner.

6 and 7 are available from:

National Audiovisual Center
National Archives and Records Administration
Customer Services Section PY
8700 Edgeworth Drive
Capitol Heights, MD 20743-3701
301/763-1896

SUGGESTED SUPPLEMENTAL RESOURCES

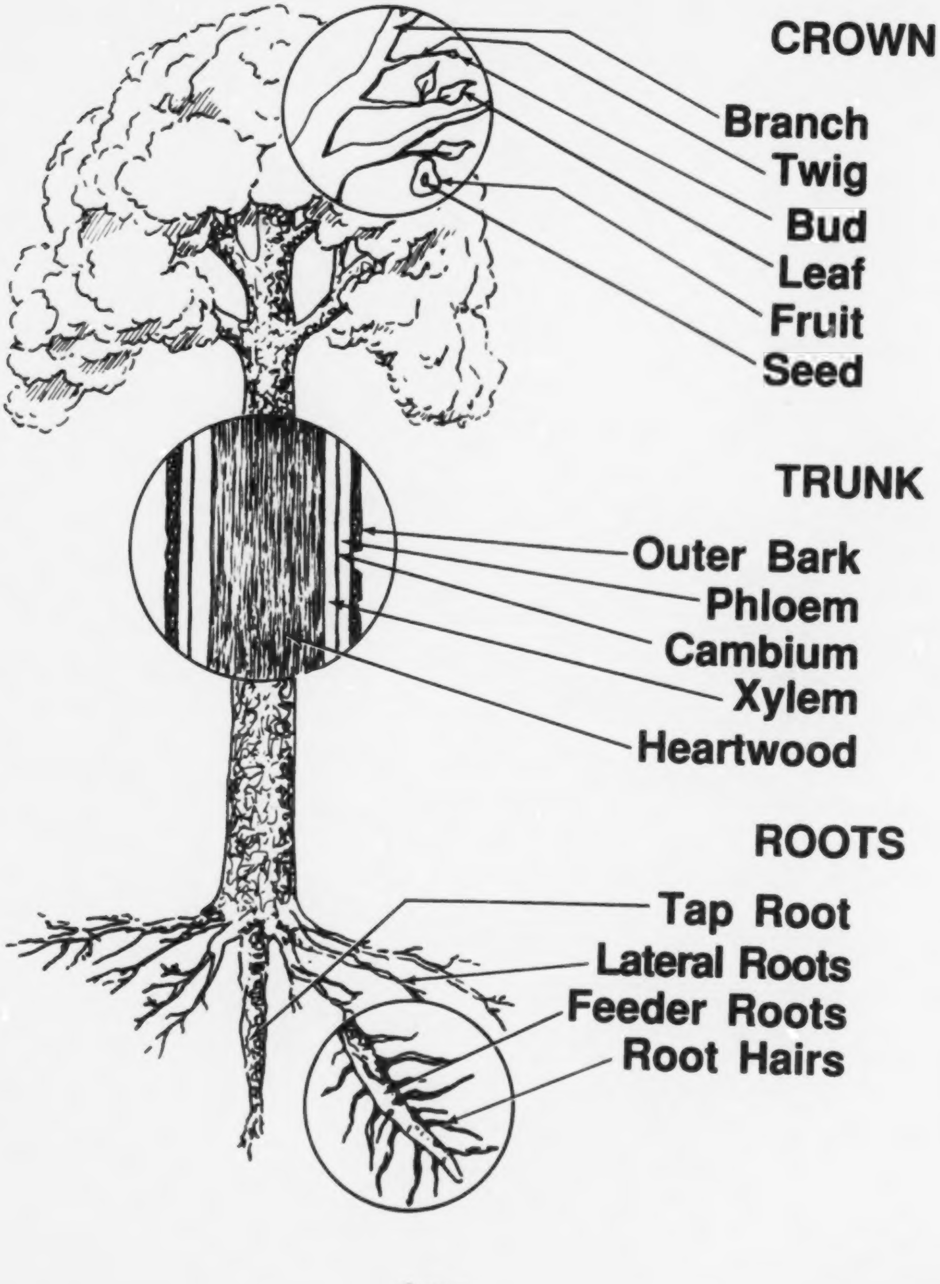
8. *Tree Growth and Identification*, H-75477 — 20 min. ½" VHS. Discusses how trees grow and how to tell one from another. Available from:

   Hobar Publications
   1234 Tiller Lane
   St. Paul, MN 55112
   612/633-3170

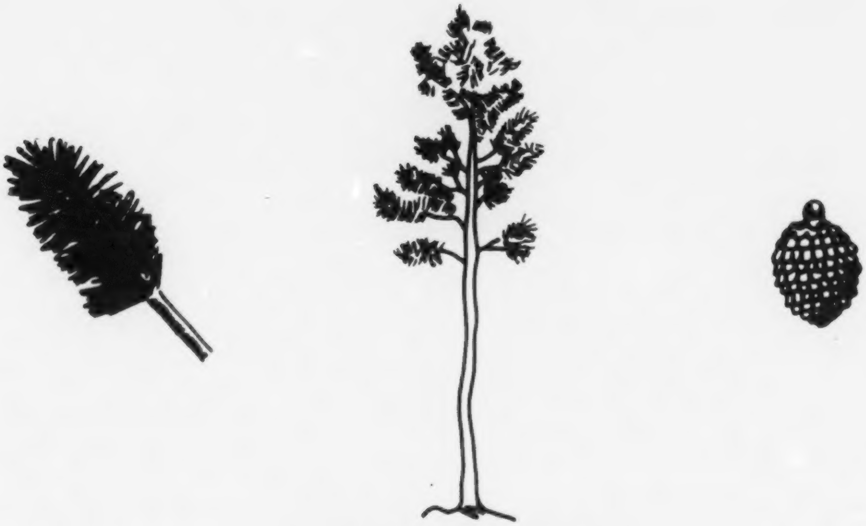
9. *Wildfire Strikes Home* (3 parts) — Part 1 is 14 min., Part 2 is 15 min., and Part 3 is 23 min. Shows firefighting, problems with interface areas and fires, and what can be done about fires. Produced by:

   U.S. Forest Service
   P.O. Box 96090
   Washington, D.C. 20090-6090

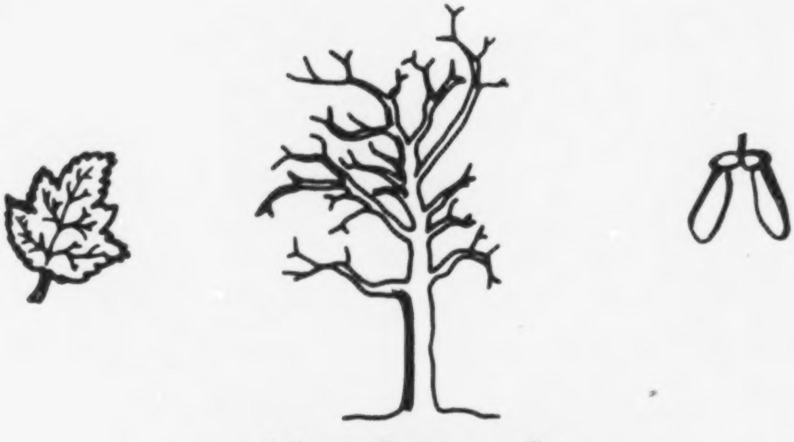
Main Parts of a Tree


CROWN
Branch
Twig
Bud
Leaf
Fruit
Seed
TRUNK
Outer Bark
Phloem
Cambium
Xylem
Heartwood
ROOTS
Tap Root
Lateral Roots
Feeder Roots
Root Hairs

Types of Wood

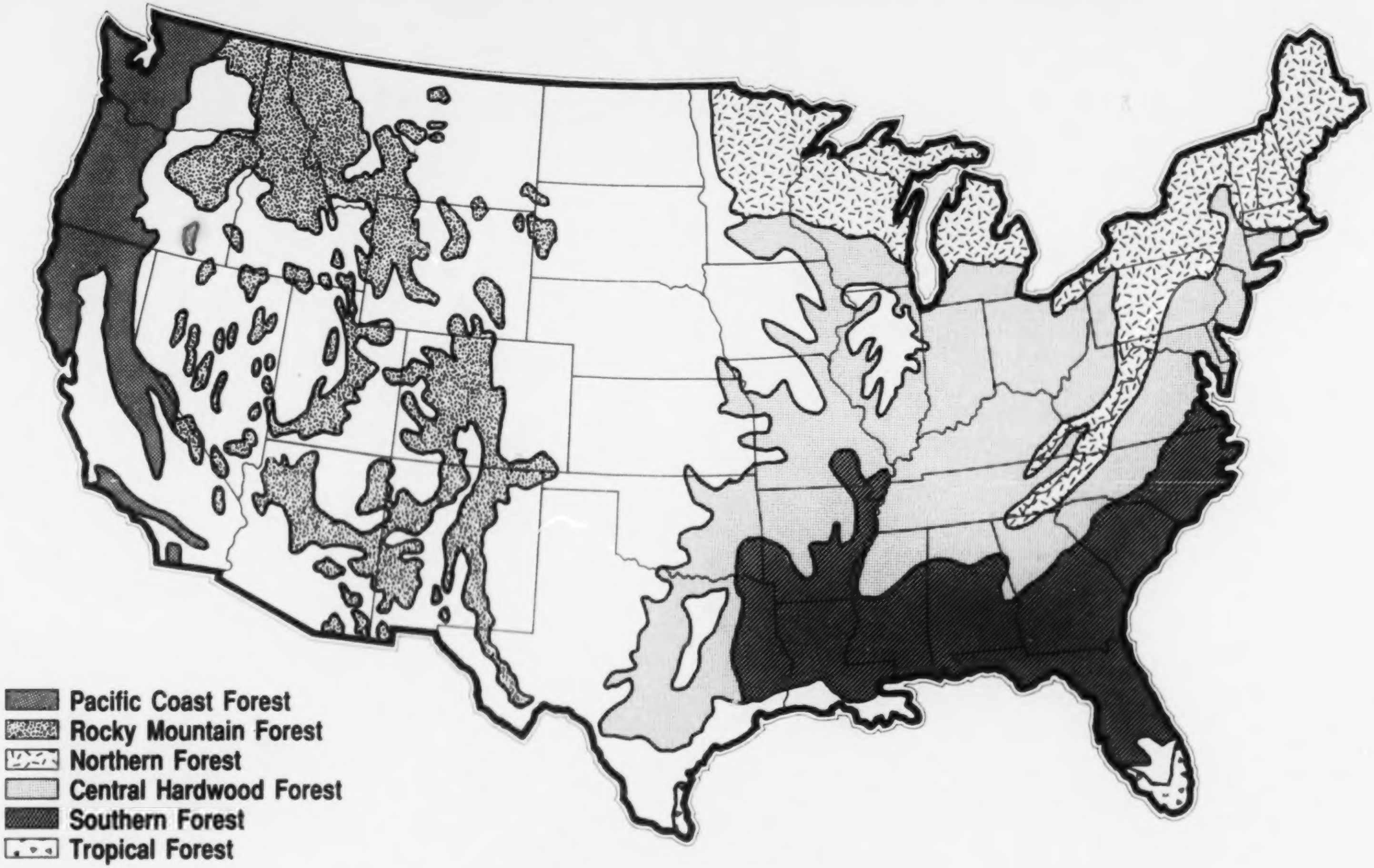


Softwoods
From Coniferous Trees



Hardwoods
From Deciduous Trees

Forest Regions of the United States


Pacific Coast Forest
Rocky Mountain Forest
Northern Forest
Central Hardwood Forest
Southern Forest
Tropical Forest

TM 3

FORESTRY
UNIT VIII

INFORMATION SHEET

I. Terms and definitions

A. Bole — The stem or trunk of a tree

B. Broadleaf — Trees that have wide, flat leaves

C. Commercial forests — Land capable of producing an economically useful forest

D. Chlorophyll — Green photosynthetic coloring matter in plants

E. Conifer — Trees that bear seeds in cones and that have long, narrow, (needle-like) leaves

(NOTE: Almost all conifers are evergreen.)

F. Deciduous — Plants that shed all of their leaves at the end of the growing season and remain leafless during the dormant (non-growing) season

Examples: Maple trees, crab apple trees, lilac shrubs

G. Defoliation — Loss of leaves, especially prematurely

H. Dendrology — The study of trees

I. Evergreen — Plants that retain their green foliage (leaves) throughout the year

Examples: Pine trees, fir trees, hollies

J. Forage — All browse and non-woody food that is available to livestock or game animals

K. Forest — A complex community of associated trees, shrubs, other plants, and animals

L. Forestry — The art and science of managing forests so as to yield, on a continuous basis, a maximum in quality and quantity of forest lands to satisfy human needs

M. Nutrients — Mineral elements and compounds (including water and air) which a plant uses for tissue growth and maintenance

N. Photosynthesis — The process of producing carbohydrates from water, carbon dioxide, chlorophyll, and light

O. Sap — The liquid that circulates through the tissue of woody plants

P. Silviculture — The art of producing and caring for a forest

INFORMATION SHEET

Q. Transpiration — The release of water vapor by the leaves into the air

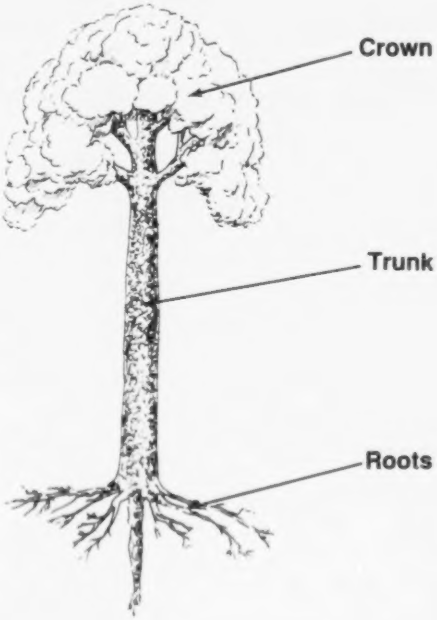
R. Tree — A single-stemmed woody plant usually over 20 feet high at maturity

II. **Main parts of a tree**

A. Crown — The foliage and flowering/fruiting part of the tree

B. Trunk — The main stem of the tree that transports nutrients

C. Roots — The underground part of a tree that extracts nutrients from the soil and atmosphere



III. **Parts of the crown**

A. Branches — Larger, outgrowing stems from the trunk

B. Twigs — Smaller stems from the branches

C. Buds — Small, growing projections at the ends or sides of stems that may develop into a flower, leaf, or shoot (new twig)

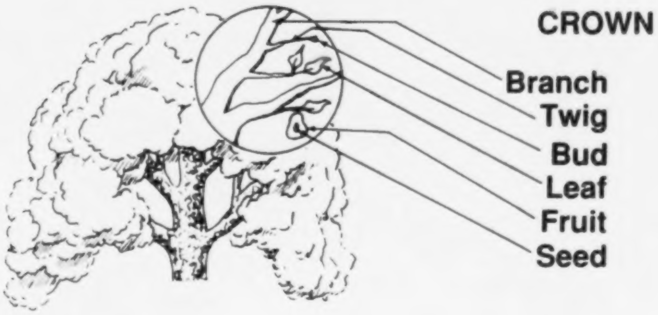
D. Leaves — Single unit of foliage that functions primarily in food manufacture through photosynthesis

E. Flowers — The reproductive part of a seed-bearing plant

F. Fruit — The edible, more or less soft product of a plant, consisting of ripened seeds and adjacent tissues or tissue only (seedless)

G. Seeds — The small bodies produced by flowering plants which are capable of developing by germination (sprouting)

INFORMATION SHEET


CROWN
Branch
Twig
Bud
Leaf
Fruit
Seed

IV. Parts of the trunk

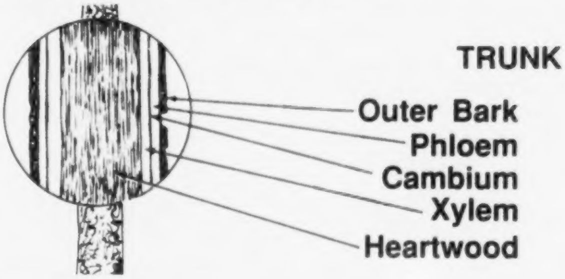
A. Outer bark — Protects tree from injuries

B. Phloem — Carries food from leaves to twigs, branches, trunk, and roots

C. Cambium — Living cells that divide to form phloem and xylem

D. Xylem — Carries sap from roots to leaves

E. Heartwood — Dead cells that give strength to the tree

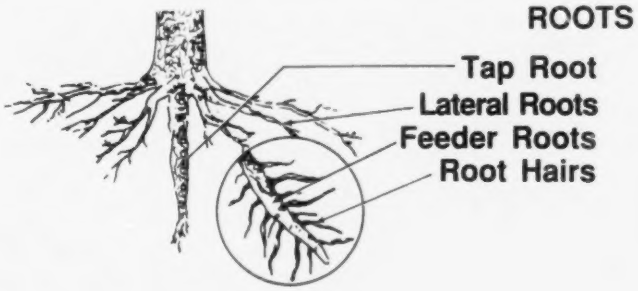

TRUNK
Outer Bark
Phloem
Cambium
Xylem
Heartwood

V. Types of roots and their functions

A. Lateral roots — Grow horizontally and help keep the tree upright

B. Tap roots — Grow vertically downward and anchor the tree

C. Feeder roots and root hairs — Absorb water and minerals


ROOTS
Tap Root
Lateral Roots
Feeder Roots
Root Hairs

INFORMATION SHEET

VI. **Ways trees are identified** (Assignment Sheet #1)

(NOTE: Not all of the following are present on the tree at the same time depending on the season and the type of tree.)

A. Leaves

B. Fruits

C. Bark

D. Buds

E. Twigs

F. Flowers

G. Wood

H. Growth habit

I. Overall form

VII. **Photosynthesis process**

A. The leaves of a plant use sunlight, carbon dioxide, chlorophyll, and water to produce carbohydrates.

B. Oxygen is given off as a by-product.

C. Carbohydrates, including sugars and starches, are later converted to fats and proteins.

D. Fats and proteins are used as food for growth and respiration or are stored in the plant for later use.

INFORMATION SHEET

VIII. **Growth of a tree** (Assignment Sheet #2)

- A. Trees begin growth in the spring when the temperature is warm enough.
- B. Growth is slower in the summer because of the hot, dry weather.
- C. Cells are the building blocks of trees.
- D. Root tips, twigs, and branches increase in length when cells become longer.
- E. The tree increases in diameter when cells under the bark divide.
- F. New growth from under the bark forms the annual ring.
- G. One ring is produced each year.
- H. The age of a tree can be determined by counting the number of rings from the center out to the edge.
- I. The width of the growth ring indicates the tree's growing conditions that year.

IX. **Classifications of trees** (Assignment Sheet #3)

- A. Hardwood — Wood produced by deciduous (broadleaf) trees
- B. Softwood — Wood produced by conifers

(NOTE: This classification does not always indicate the degree of hardness of the wood. Some softwoods such as firs are actually harder than some hardwoods such as fruit trees.)

X. **Common uses of trees**

- A. Shade — As shields from the sun which help to cool nearby areas in the summer
- B. Windbreaks — As shields from undesirable winds and to reduce wind erosion
- C. Privacy and noise buffers — As shields from undesirable views or noises
- D. Ornamental use — For beauty in a landscape
- E. Fruit and nut production
- F. Timber production — Various uses of wood products (Assignment Sheet #4)

(NOTE: Depending on the type of tree, it may have several uses. For example, an apple tree is ornamental when it blooms, it produces fruit, it gives shade, and its wood may be used for various products.)

INFORMATION SHEET

XI. Benefits of forests to the environment

A. Influence the climate

B. Retain snowmelts

C. Prevent floods

D. Control water erosion

E. Control wind erosion

F. Provide habitats for fish and wildlife

G. Remove pollutants from the environment

H. Provide organic matter (leaves, decaying parts) to the soil

I. Provide oxygen to the atmosphere

J. Remove carbon dioxide from the atmosphere

XII. Government forestry agencies

A. Forest Service

B. National Park Service

C. Bureau of Land Management

D. Bureau of Indian Affairs

E. State forestry service

F. City and county governments

XIII. Major forest regions of the continental United States

A. Pacific Coast

B. Rocky Mountain (Western)

C. Northern

D. Central Hardwood

E. Southern

F. Tropical

INFORMATION SHEET

2. Release cutting — Resembles thinning but is used to regulate species composition or improve the growth and quality of a young stand up to *sapling* size; also used to remove or control competing vegetation other than trees

3. Improvement cutting — Adjusts species composition and tree quality in previously unmanaged stands that are *older* than the sapling stage; removes trees of undesirable species, poor form, and unhealthy condition

4. Salvage cutting — Removing trees killed or damaged by fire, ice, storms, or natural catastrophes

5. Sanitation cutting — Removing trees damaged by diseases or insects

XV. **Ways that tree stands regenerate**

A. Seeding (natural or direct)

B. Stump sprouting

C. Planting of seedlings (Job Sheet #1)

XVI. **Forest measurements** (Assignment Sheet #5)

A. Cord — A stack of wood 4 feet by 4 feet by 8 feet or 128 cubic feet

B. Board ft. — Rough wood one foot square and one inch thick

C. Cubic ft. — Rough wood one foot on each side; contains about six board feet

D. Weight — Used commonly in the pulp and paper industry

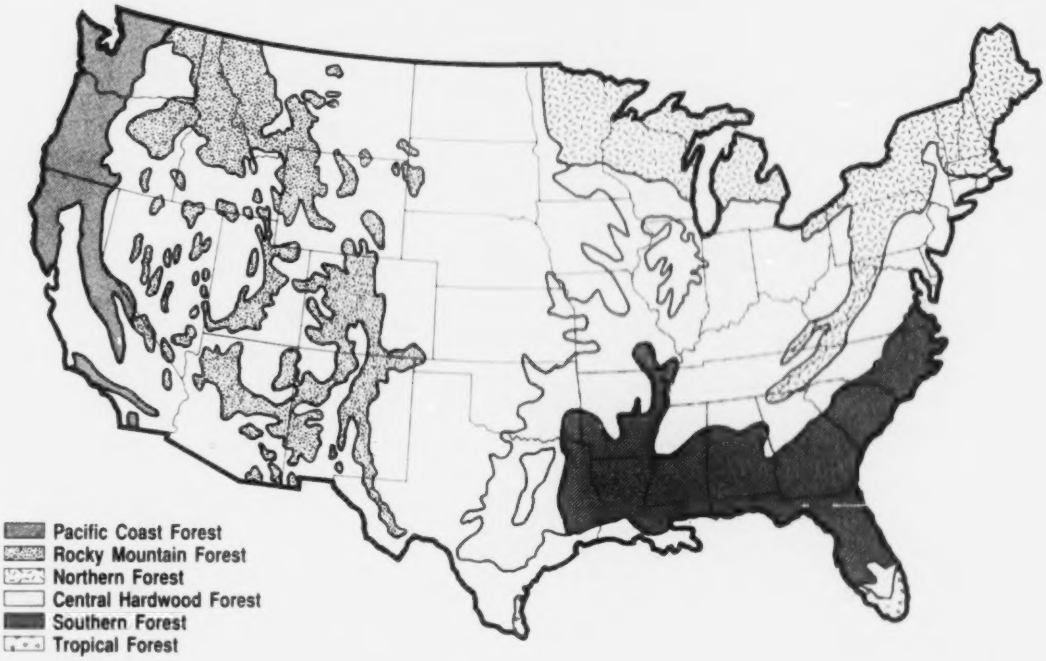
E. Piece — Refers to the number of boards of a specific dimension

F. Diameter — The distance across a tree at 4.5 feet above the ground

(NOTE: This is also referred to as diameter breast high [DBH].)

INFORMATION SHEET

Forest Regions of the United States


Pacific Coast Forest
Rocky Mountain Forest
Northern Forest
Central Hardwood Forest
Southern Forest
Tropical Forest

XIV. Types of forest cuttings

A. Harvest cuttings — Removing financially or physically mature (marketable) trees for timber

1. Selective cutting — Individual marketable trees are selected and cut; commonly used in uneven-aged stands

2. Clear cutting — All the trees in a stand are harvested in a single operation; commonly used in even-aged stands

   (NOTE: A variation of clear cutting is the seed-tree method where single or small groups of superior trees are left to produce seed for regeneration.)

B. Intermediate cuttings — Cuttings made in an immature stand to improve the stand's composition and character

(NOTE: Intermediate cuttings are often termed "timber stand improvement.")

1. Thinning — Removing surplus trees, thereby reducing competition and improving the growth and quality of the remaining trees

INFORMATION SHEET

XVIII. Forest (tree) enemies

- A. Insects

  Examples: Bark beetles, reproduction weevils, pine tip moths, budworms, gypsy moths, tent caterpillars, leafrollers, stem borers

- B. Diseases
  - 1. Noninfectious diseases — Caused by environmental stress

    Examples: Maple decline, birch dieback, sweetgum blight

  - 2. Infectious diseases — Caused by parasites and fungi

    Examples: Rust, root rot, mistletoe, stem decay, canker, Dutch elm disease, oak wilt

- C. Physical damage
  - 1. Overgrazing
  - 2. Construction of buildings and roads
  - 3. Wind
- D. Fire
  - 1. Accidental
  - 2. Intentional

XIX. Causes of fire

- A. Arson
- B. Debris burning
- C. Smokers
- D. Railroads
- E. Logging operations
- F. Lightning

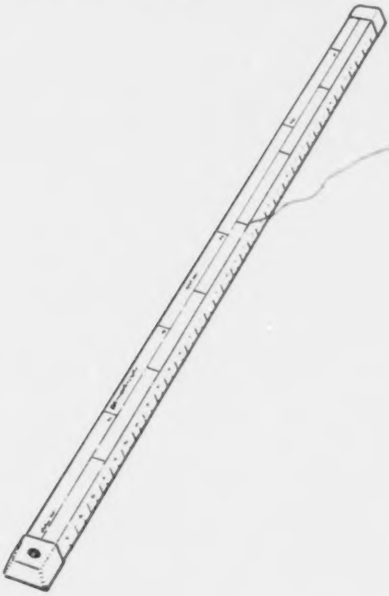
XX. Types of forest fires

- A. Ground fires — Burn the organic materials beneath the surface litter
- B. Surface fires — Burn surface litter
- C. Crown fires — Burn from top to top of trees or shrubs

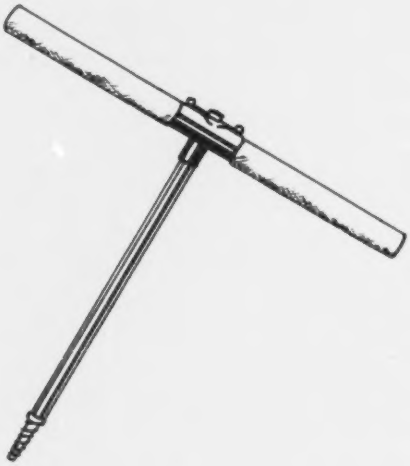
INFORMATION SHEET

XVII. **Measuring instruments used in forestry** (Job Sheets #2 and #3)

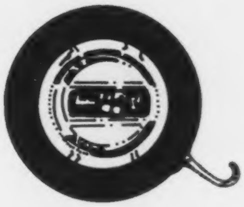
A. Tree scale (Biltmore) stick— Used to measure tree diameter and tree height



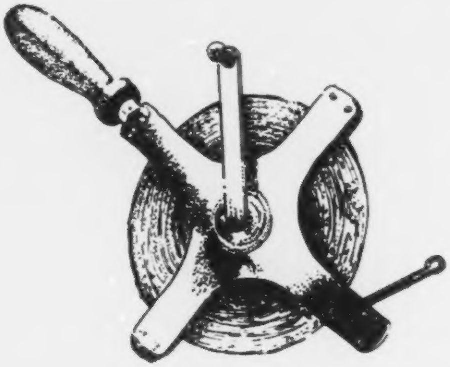
B. Increment borer — An augerlike tool used to extract cores from trees for the determination of growth and age



C. Diameter tape — Used to directly measure the diameter of a tree



D. Chains or tapes — Used to determine horizontal distances



INFORMATION SHEET

XXI. Categories of forest fires

A. Wildfire — Fires burning out of control

B. Controlled (prescribed) burn — Any burning that has been started intentionally as a forest management tool

XXII. Benefits of controlled burns

A. Reduces the hazard of wildfire

B. Readies the area for seeding and planting

C. Stimulates sprouts and seedlings, thereby improving food sources for many wildlife

D. Removes undesirable trees and brush

E. Controls forest diseases

F. Increases nutrient levels in forage

G. Creates openings in dense forest stands which encourages natural regeneration of forest

H. Makes access to the forest easier

XXIII. Careers in forestry

A. Foresters

(NOTE: This includes timber sale inspectors, administrators, assistants, and silviculturists.)

B. Forestry technicians

C. Loggers

D. Log scalers

E. Forestry researchers and industry representatives

FORESTRY
UNIT VIII

ASSIGNMENT SHEET #1 — IDENTIFY SPECIFIC TREES

NAME______________________________ SCORE ____________________

EVALUATION CRITERIA

Criteria	Rating
Directions are followed	______
Assignment is neat and completed on time	______
Ten samples are correctly mounted	______
Ten samples are correctly labeled	______

Directions: Collect leaf samples of ten (10) common trees in your area. Mount these. Identify your trees according to resource books provided by your instructor or library. Label the respective mounts with the common tree name.

FORESTRY
UNIT VIII

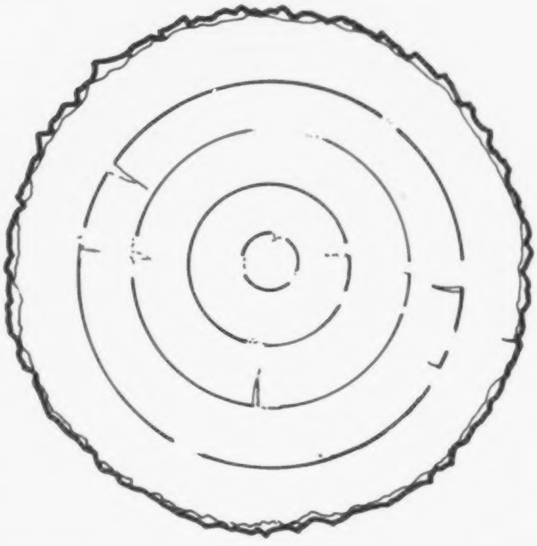
ASSIGNMENT SHEET #2 — DETERMINE THE AGE OF A TREE

NAME______________________________ SCORE ____________________

EVALUATION CRITERIA

Criteria	Rating
Directions are followed	______
Assignment is completed on time	______
Age is correct	______

Directions: Given the following cross section of a tree or one provided by your instructor, determine the age by counting the rings. Rings should be counted from the center out.



FORESTRY
UNIT VIII

ASSIGNMENT SHEET #3 — CLASSIFY LOCAL TREES

NAME______________________________ SCORE ________________

EVALUATION CRITERIA

Criteria	Rating
Directions are followed	_____
Assignment is neat and completed on time	_____
Ten trees are listed	_____
Trees are classified correctly	_____

Directions: With the help of your instructor, develop a list of ten (10) trees which are most common in your area. Classify the tree by placing the proper symbols beside the tree name.

Name of Tree	c — conifer or d — deciduous	s — softwood or h — hardwood
1. __________	_____	_____
2. __________	_____	_____
3. __________	_____	_____
4. __________	_____	_____
5. __________	_____	_____
6. __________	_____	_____
7. __________	_____	_____
8. __________	_____	_____
9. __________	_____	_____
10. __________	_____	_____

FORESTRY
UNIT VIII

ASSIGNMENT SHEET #4 — DETERMINE USES OF WOOD AND WOOD BY-PRODUCTS

NAME______________________________ SCORE _______________

EVALUATION CRITERIA

Criteria	Rating
Directions are followed	_____
Assignment is neat and completed on time	_____
Ten products and uses are listed	_____

Directions: Make a list of woods and wood by-products and their uses

Woods or Wood By-Products	Uses
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

FORESTRY
UNIT VIII

ASSIGNMENT SHEET #5 — SOLVE CORD MEASUREMENT PROBLEMS

NAME____ SCORE ______________________

Directions: Using the formulas provided, solve the following cord measurement problems by placing the answers in the spaces provided.

a. 2 x 4 x 6 =

b. 2 x 4 x 8 =

c. 4 x 4 x 6 =

d. 4 x 4 x 4 =

e. 2 x 2 x 20 =

f. 4 x 6 x 8 =

g. 2 x 8 x 8 =

h. 4 x 4 x 20 =

i. 2 x 6 x 10 =

j. 8 x 8 x 10 =

1. Length x width x height = ____ cubic feet

a. ______ f. ______

b. ______ g. ______

c. ______ h. ______

d. ______ i. ______

e. ______ j. ______

2. Cubic feet/128 = ______% of a cord

a. ______ f. ______

b. ______ g. ______

c. ______ h. ______

d. ______ i. ______

e. ______ j. ______

ASSIGNMENT SHEET #5

3. Percent of cord x cost of cord = _____ cost of the pile of wood

(NOTE: Assume the cost of a cord for this problem is $70.00.)

a. _____
b. _____
c. _____
d. _____
e. _____
f. _____
g. _____
h. _____
i. _____
j. _____

FORESTRY
UNIT VIII

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheets #1 - #4 — Evaluated according to the stated criteria

Assignment Sheet #5

1. a. 48 cu. ft.
   b. 64
   c. 96
   d. 64
   e. 80
   f. 192
   g. 128
   h. 320
   i. 120
   j. 640

2. a. 37.5%
   b. 50
   c. 75
   d. 50
   e. 62.5
   f. 150
   g. 100
   h. 250
   i. 93.8
   j. 500

3. a. $26.25
   b. $35.00
   c. $52.50
   d. $35.00
   e. $43.75
   f. $105.00
   g. $70.00
   h. $175.00
   i. $65.55
   j. $350.00

FORESTRY
UNIT VIII

JOB SHEET #1 — PLANT A BAREROOT TREE

EVALUATION CRITERIA

Criteria	Rating
Demonstrated proper use of equipment	______
Properly prepared hole	______
Properly placed tree	______
Practiced safety rules throughout procedure	______

A. Tools and materials

1. Spade
2. Sand shovel
3. Yard stick
4. Plastic sheeting
5. Peat moss or other organic matter
6. Bareroot tree
7. Safety equipment as needed — gloves, hard hats, eye and ear protection

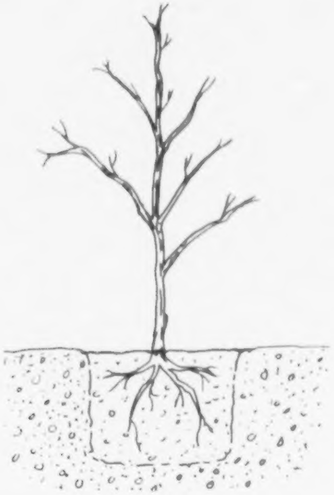
B. Procedure

1. Assemble the needed tools and materials, and carry them to the planting site.
2. Make a planting hole with the shovel, twice as wide and slightly deeper than the root mass of the tree.
3. As you remove soil from the hole, place it on plastic sheeting and mix it with organic matter or peat moss.
4. Adjust depth of hole by adding soil mixture so the tree will be the same depth or slightly higher than it was in the nursery.
5. Place the yard stick across the hole to assist in the depth determination.

JOB SHEET #1

6. Remove any broken or damaged roots from the root mass.
7. Place the tree in the hole, making sure the roots are in a natural position.
8. Straighten tree, viewing it from all sides.
9. Fill in the hole with the soil mixture.

FIGURE 1



10. Thoroughly soak the soil to eliminate air pockets.
11. After water drains away, fill in with the rest of the soil mixture and soak again.
12. Return tools and equipment to the storage area and put away properly.

FORESTRY
UNIT VIII

JOB SHEET #2 — MEASURE DIAMETER OF A TREE

EVALUATION CRITERIA

Criteria	Rating
Demonstrated proper use of equipment	________
Measured correct height	________
Made correct readings	________
Practiced safety rules throughout procedure	________

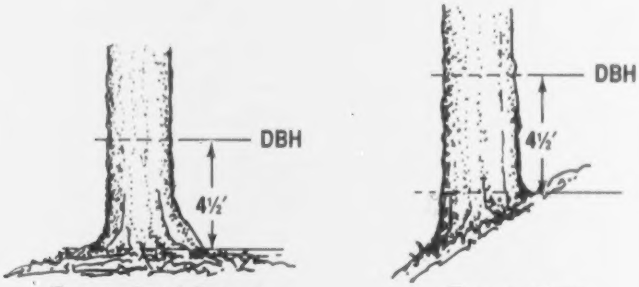
A. Tools and materials

1. Diameter tape
2. Carpenter's tape
3. Safety equipment as needed — gloves, hard hats, eye and ear protection

B. Procedure

1. Assemble the needed tools and materials, and carry them to the tree site.
2. With the carpenter's tape, measure to a height of 4.5 feet (DBH) above the ground level or on uphill side of tree. (Figure 1)

FIGURE 1



Tree on Level Ground

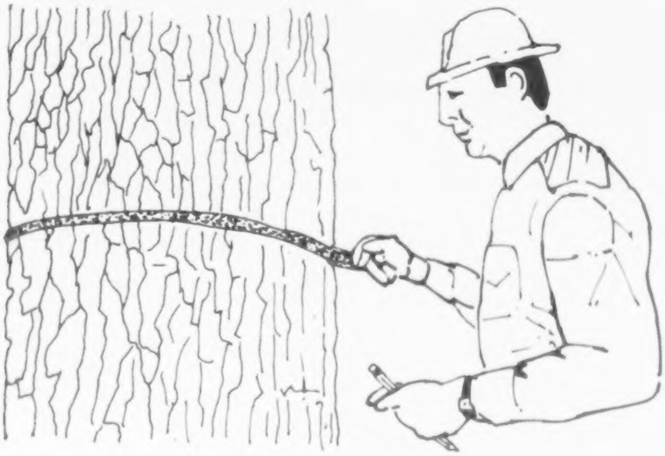
Tree on Slope

3. Secure the end of the diameter tape to the bark at the 4.5 foot height.

JOB SHEET #2

4. Extend the diameter tape around the tree until it meets the end. (Figure 2)

FIGURE 2



5. Read the diameter directly from the tape to the nearest inch.

6. Return tools and equipment to the storage area, and put away properly.

FORESTRY
UNIT VIII

JOB SHEET #3 — MEASURE MERCHANTABLE HEIGHT OF A TREE

EVALUATION CRITERIA

Criteria	Rating
Demonstrated proper use of equipment	________
Made accurate distance measurement	________
Held tree scale properly	________
Practiced safety rules throughout procedure	________

A. Tools and materials

1. Tree scale stick (Biltmore stick)
2. 100 foot tape
3. Safety equipment as needed — gloves, hard hats, eye and ear protection

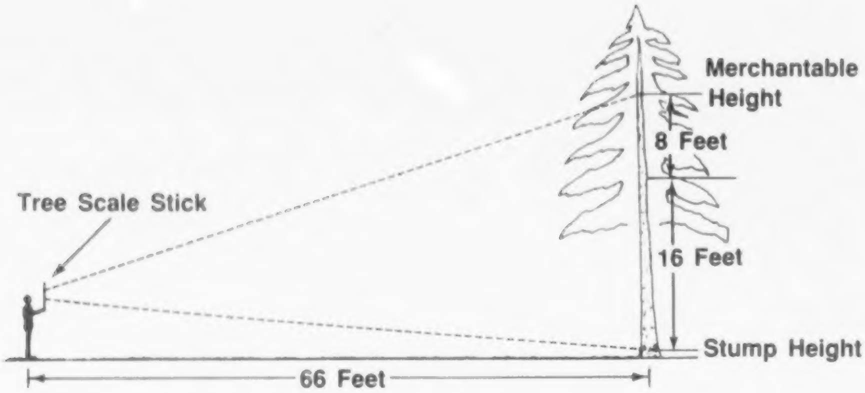
B. Procedure

1. Assemble the needed tools and materials, and carry them to the site where tree is to be measured.
2. Measure a distance of 66 feet from the base of the tree.
3. While standing at the 66-foot mark, hold the stick outright, 25 inches from the eye.
4. View the bottom of the stick at the cut-off point for sawtimber trees [stump height] (6-10 inches from the ground).
5. View the merchantable height of the tree (6" diameter inside bark).

JOB SHEET #3

6. Using the tree scale, determine how many 16-foot logs and half logs can be cut from the tree.

FIGURE 1


Merchantable Height
8 Feet
Tree Scale Stick
16 Feet
Stump Height
66 Feet

7. Return tools and equipment to the storage area, and put away properly.

FORESTRY
UNIT VIII

TEST

NAME ________________________________ SCORE ________

1. Match the terms on the right with the correct definitions.

______ a. A complex community of associated trees, shrubs, other plants, and animals

______ b. Loss of leaves, especially prematurely

______ c. The art and science of managing forests so as to yield, on a continuous basis, a maximum in quality and quantity of forest lands to satisfy human needs

______ d. Trees that bear seeds in cones and that have long, narrow (needlelike) leaves

______ e. Mineral elements and compounds which a plant uses for tissue growth and maintenance

______ f. The art of producing and caring for a forest

______ g. The process of producing carbohydrates from water, carbon dioxide, chlorophyll, and light

______ h. A single-stemmed woody plant usually over 20 feet high at maturity

______ i. Green photosynthetic coloring matter in plants

______ j. The study of trees

______ k. Plants that retain their green foliage (leaves) throughout the year

______ l. Trees that have wide, flat leaves

______ m. All browse and non-woody food that is available to livestock or nongame animals

______ n. The stem or trunk of a tree

1. Bole
2. Broadleaf
3. Chlorophyll
4. Conifer
5. Deciduous
6. Defoliation
7. Dendrology
9. Forage
10. Forest
11. Forestry
12. Nutrients
13. Photosynthesis
14. Sap
15. Silviculture
16. Transpiration
17. Tree

TEST

______ o. The release of water vapor by the leaves into the air

______ p. The liquid that circulates through the tissue of woody plants

2. Distinguish among the main parts of a tree by placing the following letters next to the correct descriptions.

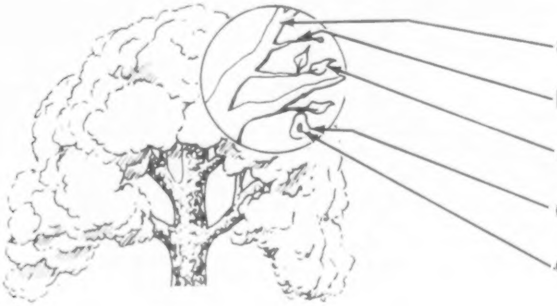
- C — Crown
- R — Roots
- T — Trunk

______ a. The main stem of the tree that transports nutrients

______ b. The foliage and flowering/fruiting part of the tree

______ c. The underground part of the tree that extracts nutrients from the soil and atmosphere

3. Identify the following parts of the crown.



a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

4. Identify the following parts of the trunk.

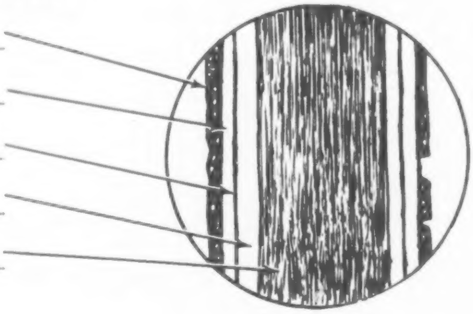
a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________



TEST

5. Distinguish among the types of roots in a root system by placing the following letters next to the correct descriptions:

    - F — Feeder roots and root hairs
    - L — Lateral roots
    - T — Tap roots

    ______ a. Grow vertically downward and anchor the tree

    ______ b. Grow horizontally and help keep the tree upright

    ______ c. Absorb water and minerals

6. List four ways that trees are identified.

    a. ____

    b. ____

    c. ____

    d. ____

7. Select true statements concerning the photosynthesis process by placing an "X" beside the statements that are true.

    ______ a. Sugars and starches are carbohydrates.

    ______ b. Fats and proteins may be used for tree growth or respiration.

    ______ c. The by-product of photosynthesis is carbon monoxide.

    ______ d. Photosynthesis may occur in the dark.

    ______ e. Fats and proteins may be stored by the tree.

8. Complete the following statements concerning the growth of a tree by circling the correct words.

    a. Trees begin growth in the (spring, summer) when the temperature is warm enough.

    b. Growth is (faster, slower) in the summer because of the hot, dry weather.

    c. Root tips, twigs, and (flowers, branches) increase in length when cells become longer.

    d. One annual ring is produced each (season, year).

    e. The (age, type) of tree can be determined by counting the number of rings.

TEST

9. Distinguish between the classifications of trees by putting an "X" next to the description of softwoods.

______ a. Wood produced by deciduous (broadleaf) trees.

______ b. Wood produced by conifers.

10. List three common uses of trees.

a. ____

b. ____

c. ____

11. Select from the following list the benefits of forests to the environment by placing an "X" beside the correct statements.

______ a. Influence the climate

______ b. Control water erosion

______ c. Retain snowmelts

______ d. Provides habitats for fish and wildlife

______ e. Encourage floods

______ f. Increase wind erosion

______ g. Increase pollutants to the environment

______ h. Provide oxygen to the atmosphere

12. List three government agencies involved in forestry.

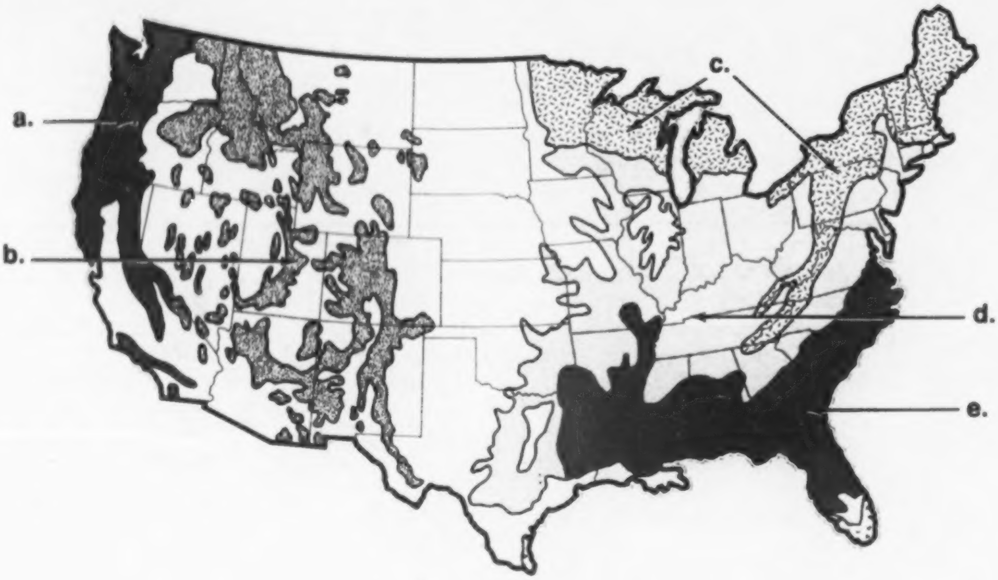
a. ____

b. ____

c. ____

TEST

13. Identify the major forest regions shown below.



a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

14. Match the types of forest cuttings with the correct definitions.

_____a. Removing trees damaged by diseases or insects

_____b. Removing surplus trees

_____c. Used to regulate species composition or improve the growth and quality of a young stand up to sapling size

_____d. All the trees in a stand are harvested in a single operation

_____e. Removing financially or physically mature trees for timber

_____f. Individual marketable trees are selected and cut

1. Clear cutting
2. Harvest cutting
3. Improvement cutting
4. Release cutting
5. Salvage cutting
6. Sanitation cutting
7. Selective cutting
8. Thinning

TEST

15. List two ways that trees regenerate.

a. ______________________________

b. ______________________________

16. Match forest measurements with the correct descriptions.

______ a. Rough wood one foot on each side; contains six board feet

______ b. Used commonly in the pulp and paper industry

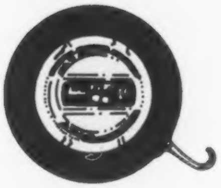
______ c. Rough wood one foot square and one inch thick

______ d. The distance across a tree at 4.5 feet above the ground

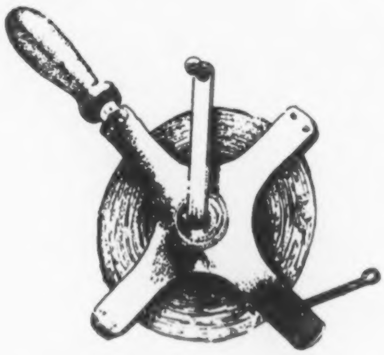
______ e. A stack of wood 4 ft. x 4 ft. x 8 ft. or 128 cu. ft.

1. Board ft.
2. Cord
3. Cubic ft.
4. Diameter
5. Piece
6. Weight

17. Identify the following measuring instruments used in forestry.

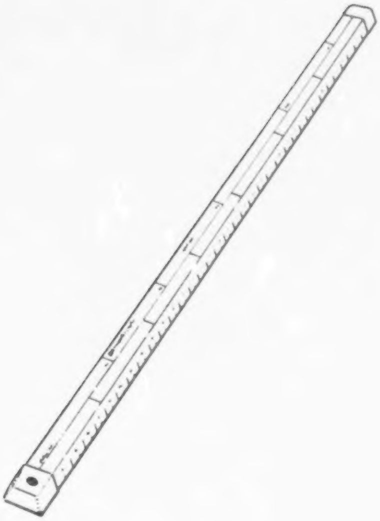


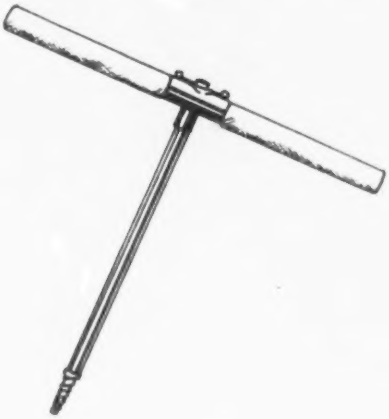
a. ______________________



b. ______________________

TEST





c. ____________________ d. ____________________

18. List three basic forest (tree) enemies.

a. ____________________

b. ____________________

c. ____________________

19. List four causes of fire.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

20. Match the types of forest fires on the right with the correct descriptions.

_____ a. Burn surface litter

_____ b. Burn from top to top of trees or shrubs

_____ c. Burn the organic matter beneath the surface litter

1. Crown fires
2. Ground fires
3. Surface fires
4. Wildfires

TEST

21. Distinguish between the categories of forest fires by placing an "X" beside the definition of controlled (prescribed) burn.

_____ a. Fires burning out of control

_____ b. Any burning that has been started intentionally as a forest management tool

22. List five benefits of controlled burns.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

23. List three careers in forestry.

a. ____________________

b. ____________________

c. ____________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

24. Identify specific trees. (Assignment Sheet #1)

25. Determine the age of a tree. (Assignment Sheet #2)

26. Classify local trees. (Assignment Sheet #3)

27. Determine uses of wood and wood by-products. (Assignment Sheet #4)

28. Solve cord measurement problems. (Assignment Sheet #5)

29. Demonstrate the ability to:

    a. Plant a bareroot tree. (Job Sheet #1)

    b. Measure diameter of a tree. (Job Sheet #2)

    c. Measure merchantable height of tree. (Job Sheet #3)

FORESTRY
UNIT VIII

ANSWERS TO TEST

1.

a.	10	e.	12	i.	3	m.	9
b.	6	f.	15	j.	7	n.	1
c.	11	g.	13	k.	8	o.	16
d.	4	h.	17	l.	2	p.	14

2. a. T
   b. C
   c. R

3. a. Branch
   b. Twig
   c. Leaf
   d. Fruit
   e. Seed

4. a. Outer bark
   b. Phloem
   c. Cambium
   d. Xylem
   e. Heartwood

5. a. T
   b. L
   c. F

6. Any four of the following:

   a. Leaves
   b. Fruits
   c. Bark
   d. Buds
   e. Twigs
   f. Flowers
   g. Wood
   h. Growth habit
   i. Overall form

7. a, b, e

ANSWERS TO TEST

8. a. Spring
   b. Slower
   c. Branches
   d. Year
   e. Age

9. b.

10. Any three of the following:

    a. Shade
    b. Windbreaks
    c. Privacy and noise buffers
    d. Ornamental use
    e. Fruit and nut production
    f. Timber production

11. a, b, c, d, h

12. Any three of the following:

    a. Forest Service
    b. National Park Service
    c. Bureau of Land Management
    d. Bureau of Indian Affairs
    e. State forestry service
    f. City and county governments

13. a. Pacific Coast
    b. Rocky Mountain (Western)
    c. Northern
    d. Central Hardwood
    e. Southern

14. a. 6
    b. 8
    c. 4
    d. 1
    e. 2
    f. 7

ANSWERS TO TEST

15. Any two of the following:

    a. Seeding (natural or direct)
    b. Stump sprouting
    c. Planting of seedlings

16. a. 3
    b. 6
    c. 1
    d. 4
    e. 2

17. a. Diameter tape
    b. Chain or tape
    c. Increment borer
    d. Tree scale (Biltmore) stick

18. Any three of the following:

    a. Insects
    b. Diseases
    c. Physical damage
    d. Fire

19. Any four of the following:

    a. Arson
    b. Debris burning
    c. Smokers
    d. Railroads
    e. Logging operations
    f. Lightning

20. a. 3
    b. 1
    c. 2

21. b

ANSWERS TO TEST

22. Any five of the following:

    a. Reduces the hazard of wildfire
    b. Readies the area for seeding and planting
    c. Stimulates sprouts and seedlings, thereby improving food sources for many wildlife
    d. Removes undesirable trees and brush
    e. Controls forest diseases
    f. Increases nutrient levels in forage
    g. Creates openings in dense forest stands which encourages natural regeneration of forest
    h. Makes access to the forest easier

23. Any three of the following:

    a. Foresters
    b. Forestry technicians
    c. Loggers
    d. Log scalers
    e. Forestry researchers and industry representatives

24-28. Evaluated to the satisfaction of the instructor.

29. Performance skills evaluated to the satisfaction of the instructor.

ENERGY RESOURCES
UNIT IX

UNIT OBJECTIVE

After completion of this unit, the student should be able to compare various energy resources, research the use of agriculture products as alternative energy resources, and perform an energy audit on a home. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to energy resources with the correct definitions.
2. Classify energy resources as renewable or nonrenewable.
3. Complete statements concerning coal energy resources.
4. Select true statements concerning oil energy resources.
5. Select true statements concerning natural gas energy resources.
6. Complete statements concerning nuclear energy resources.
7. Select true statements concerning hydropower energy resources.
8. Complete statements concerning biomass energy resources.
9. Select true statements concerning solar energy resources.
10. Complete statements concerning wind energy resources.
11. Select true statements concerning geothermal energy resources.
12. Match U.S. energy resources with their correct reserve supplies.
13. Match oil resources with the correct percentages of use in the U.S.
14. Select from a list the goals of energy conservation.
15. List ways to conserve energy.
16. List careers in energy resources.
17. Discuss the effects of a Middle East oil embargo. (Assignment Sheet #1)
18. Compare electric production from coal and nuclear fuel. (Assignment Sheet #2)

SPECIFIC OBJECTIVES

19. Research and report on using agriculture products as alternative energy resources. (Assignment Sheet #3)

20. Perform an energy audit of your home. (Assignment Sheet #4)

ENERGY RESOURCES
UNIT IX

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and should be used with the following objectives:

TM 1 — Energy Resources (Nonrenewable) — Objective 2

TM 2 — Energy Resources (Renewable) — Objective 2

TM 3 — Oil and Gas Production — Objectives 4-5

TM 4 — Nuclear Energy Production — Objective 6

TM 5 — Hydropower Production — Objective 7

TM 6 — Biomass Conversion — Objective 8

TM 7 — Solar Collector Panel — Objective 9

TM 8 — Geothermal Reservoir — Objective 11

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Integrate the following activities throughout the teaching of this unit.

1. Plan a field trip to an electric generating plant.
2. Demonstrate simple combustion emphasizing the three things required for combustion to take place: a) Something to burn, b) Heat to combustion point, and c) oxygen to support the combustion.
3. Describe how fossil fuels are formed.
4. Organize a class debate on generation of electricity from coal vs. nuclear after students have researched both fuels in Assignment Sheet #2.
5. Bring a sample of coal, unrefined oil, and unrefined uranium ore to class.
6. Discuss the many uses of coal, oil, and natural gas. Point out our heavy dependence on these energy resources is because they are used both as fuels and as raw materlas for many synthetic products.

SUGGESTED ACTIVITIES

7. Make a display of petrochemical products to show our reliance on petroleum. Ask students to think of alternative ways to make these products.
8. Have students make a list of agriculture uses of energy.
9. Discuss local energy resources and how they are used.
10. Discuss environmental problems caused by local energy resources.
11. Have students discuss ways they could conserve energy resources.
12. If students have been recycling throughout this course, have them report on that project, what they have accomplished, and what they have learned.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

RESOURCES USED IN DEVELOPING THIS UNIT

A. Moran, Joseph M., et. al. *Introduction to Environmental Science.* New York: W. H. Freeman and Company, 1980.

B. "Nuclear Electricity and Energy Independence." U.S. Council for Energy Awareness, 1777 I Street, N.W., Washington, D.C. 20006.

SUGGESTED SUPPLEMENTAL RESOURCES

Films and videotapes

A. *Green Energy.* 26 min. Examines renewable alternatives to petroleum products such as wood, corn, and garbage. Available from:

Films for the Humanities and Sciences
P.O. Box 2053
Princeton, NJ 08543
800/257-5126

B. *Power Struggle* (2 parts). 58 min., 1986, Video only. Produced by Public Policy Productions for WNET (PBS). Narrated by Meryl Streep. Discusses energy supplies and energy efficiency.

SUGGESTED ACTIVITIES

C. *Kilowatts from Cowpies: The Methane Option.* 25 min., 1982, 16mm or video. Produced by Henry Mayer, M.D. Overview of methane (biogas) as an energy resource.

B and C are available from:

Bull Frog Films, Inc.
Oley, PA 19547
800/543-FROG

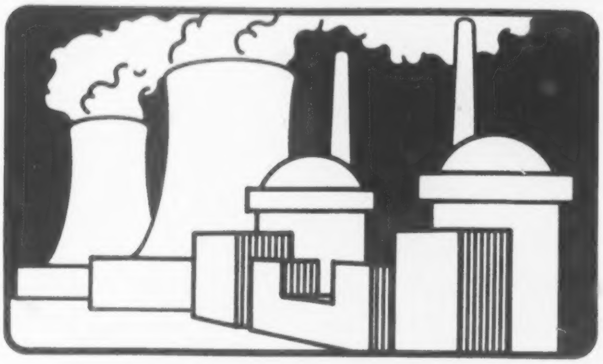
D. *Rethinking Tomorrow.*, A03832/PY. 28 min., 1980. Discusses national concerns for resource conservation.

E. *Gasohol: Growing Some of Our Fuel*, A02359/PY. 14 min., 1980. Using crop residues and sweet sorghum for alcohol production.

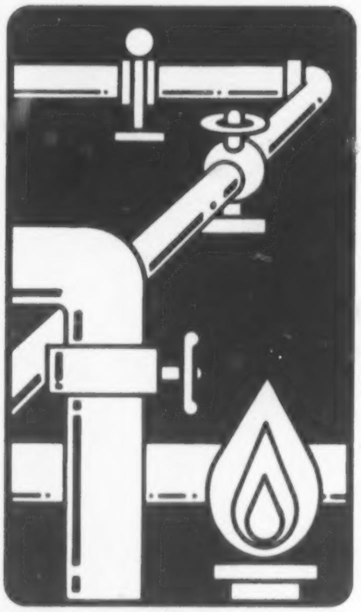
D and E are available from:

National Audiovisual Center
National Archives and Records Administration
Customer Services Section PY
8700 Edgeworth Drive
Capitol Heights, MD 20743-3701
301/763-1896

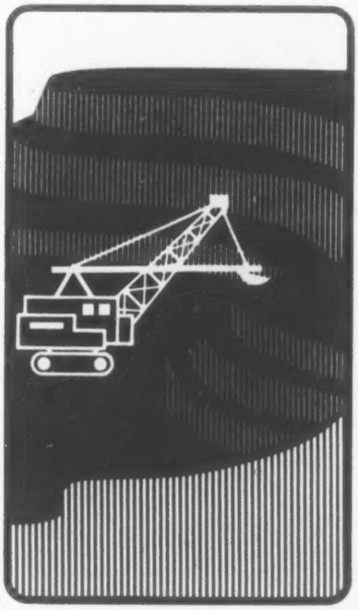
Energy Resources (Nonrenewable)



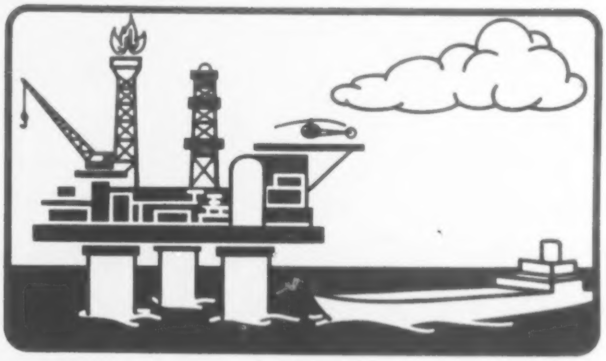
Uranium (Nuclear)



Natural Gas

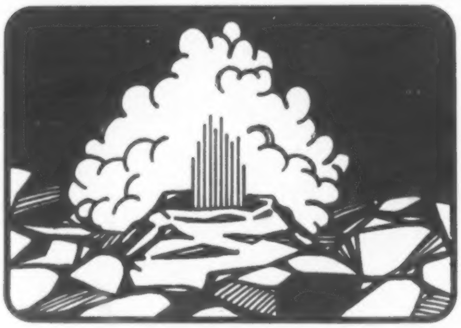


Coal

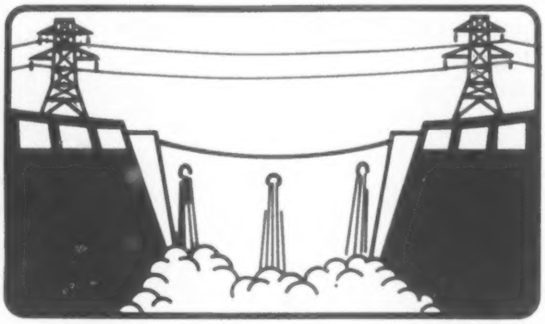


Oil

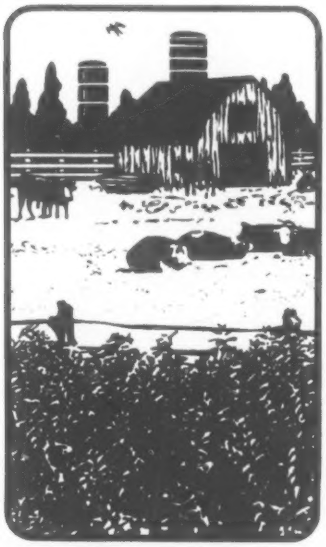
Energy Resources (Renewable)



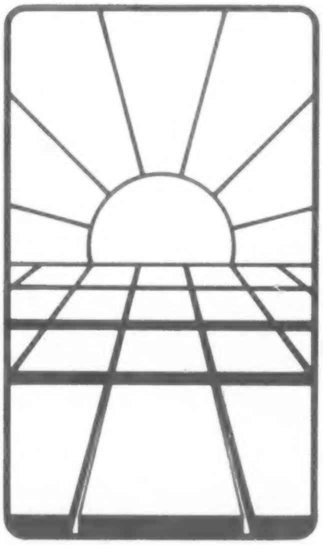
Geothermal



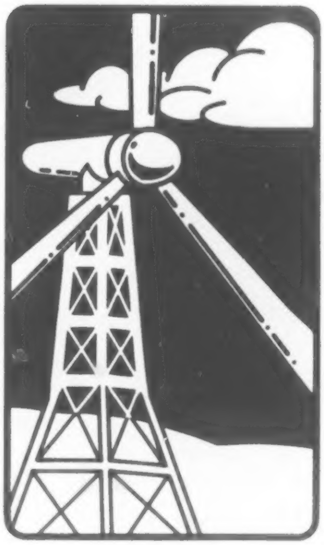
Hydropower (Water)



Biomass

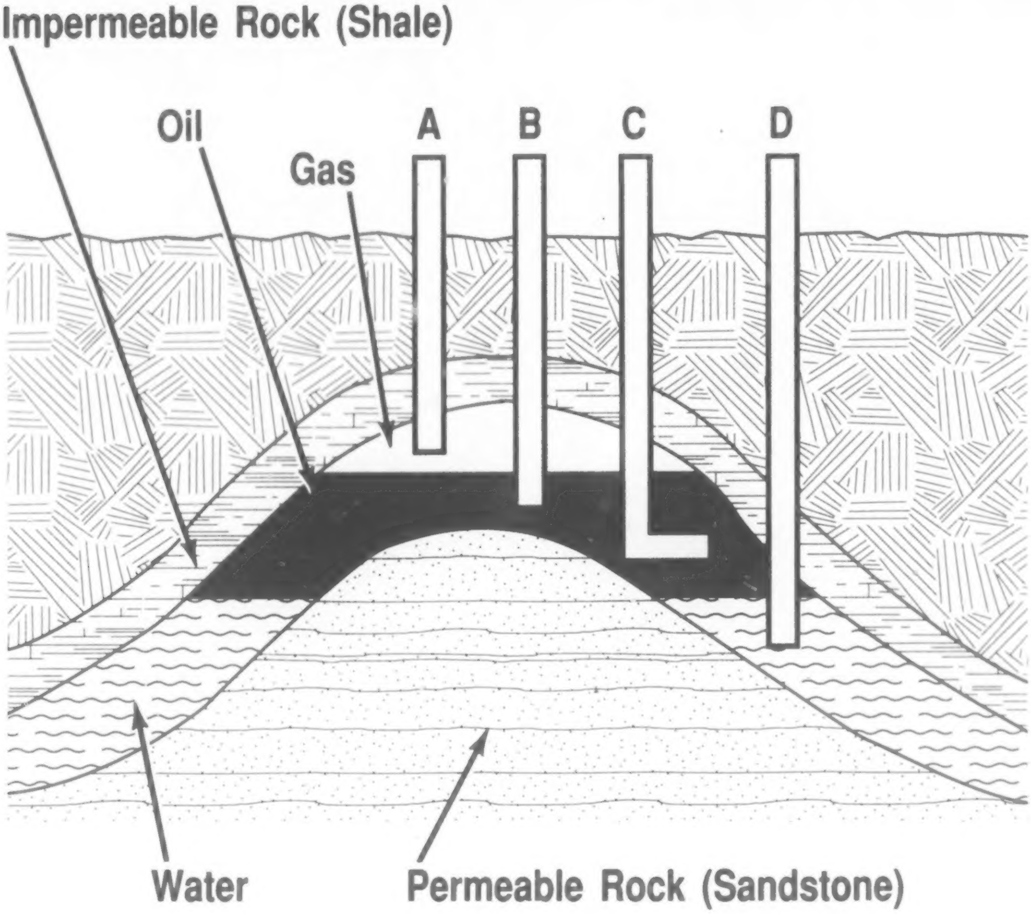


Solar



Wind

Oil and Gas Production


Impermeable Rock (Shale)
Oil
Gas
A
B
C
D
Water
Permeable Rock (Sandstone)

Well A — Gas Well

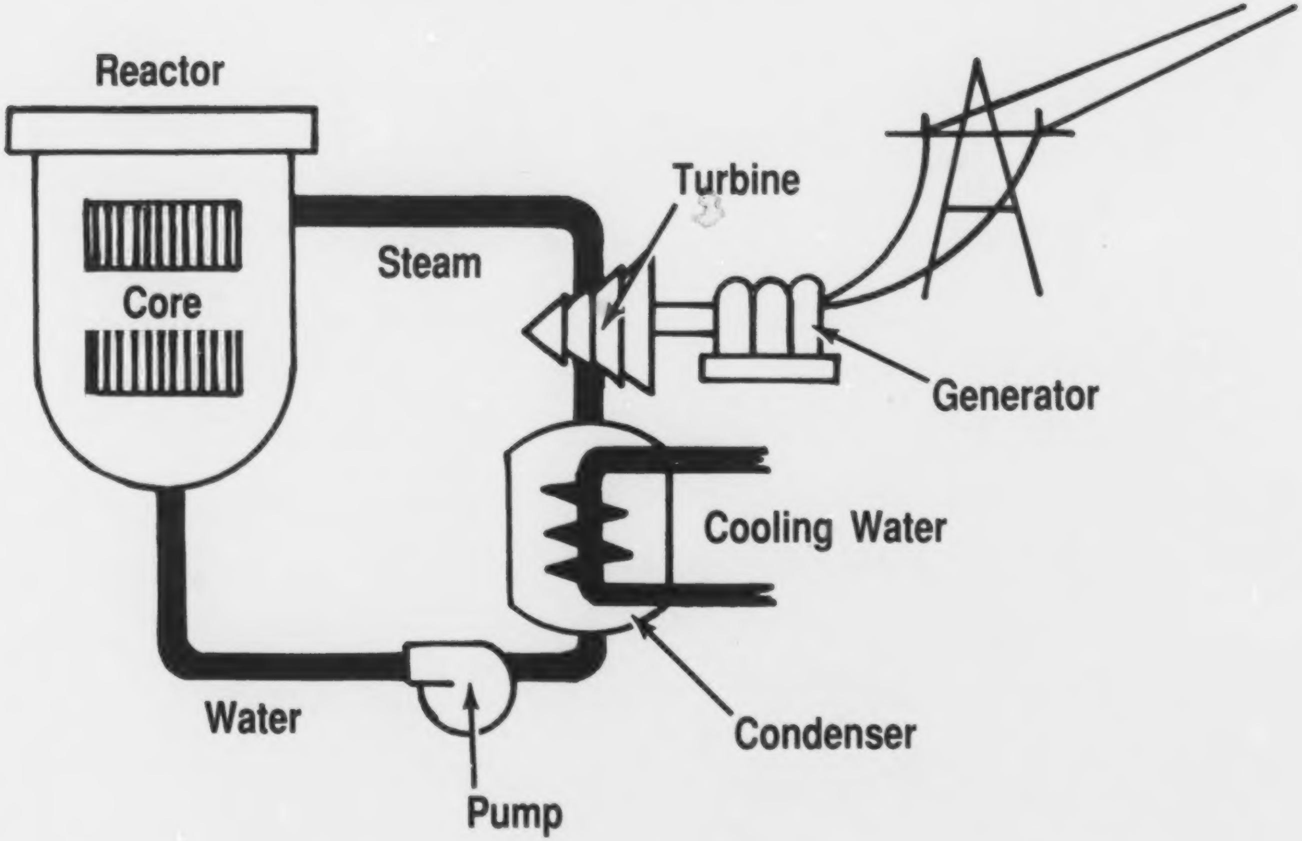
Well B — Conventional Oil Well

Well C — Horizontally Drilled Oil Well (increases production)

Well D — Water Well

(NOTE: Layers of rock trap oil and natural gas.)

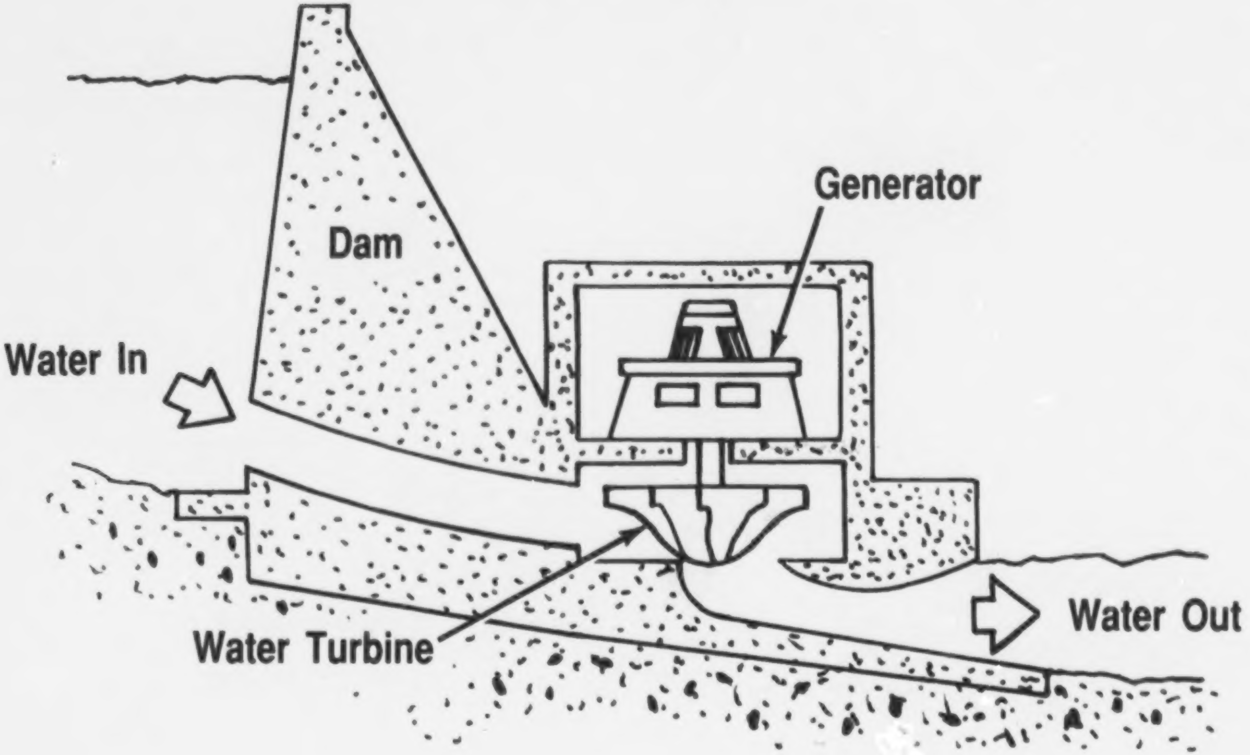
Nuclear Energy Production


Reactor
Core
Steam
Turbine
Generator
Cooling Water
Water
Pump
Condenser

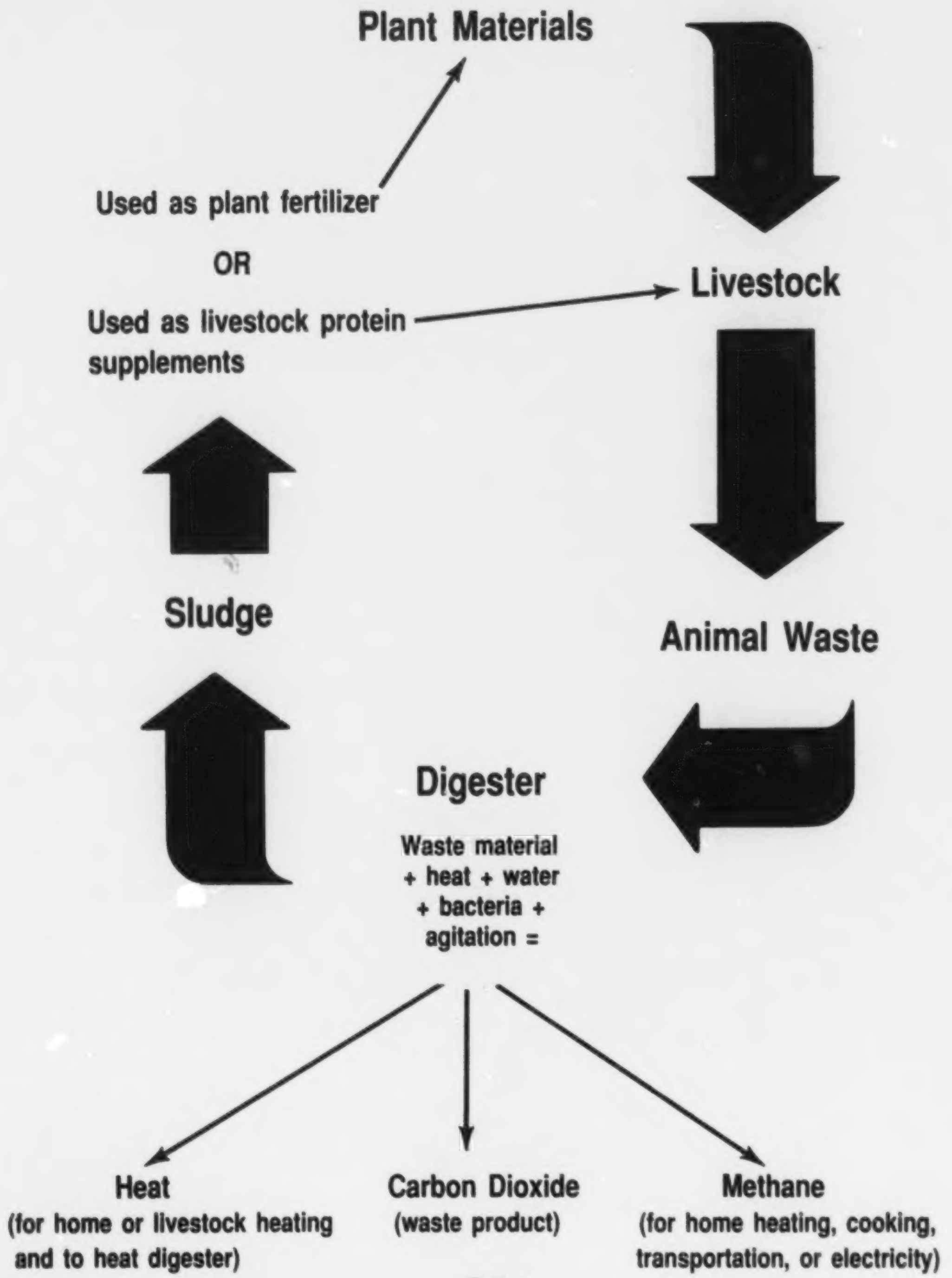
TM 4

NR-431

Hydropower Production


Generator
Dam
Water In
Water Turbine
Water Out

Biomass Conversion



Plant Materials

Livestock

Animal Waste

Digester

Waste material
+ heat + water
+ bacteria +
agitation =

Heat
(for home or livestock heating
and to heat digester)

Carbon Dioxide
(waste product)

Methane
(for home heating, cooking,
transportation, or electricity)

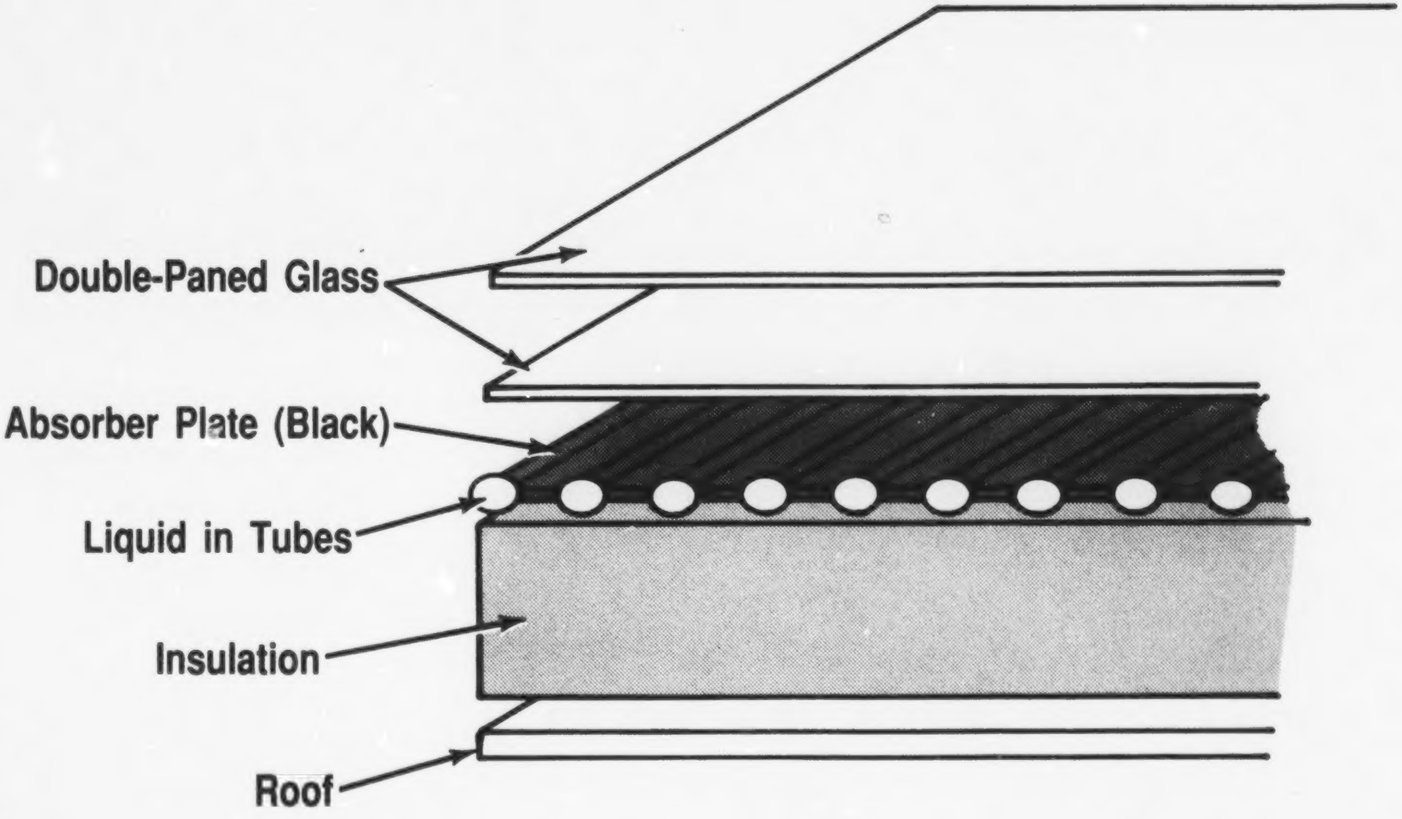
Sludge

Used as plant fertilizer

OR

Used as livestock protein
supplements

Solar Collector Panel

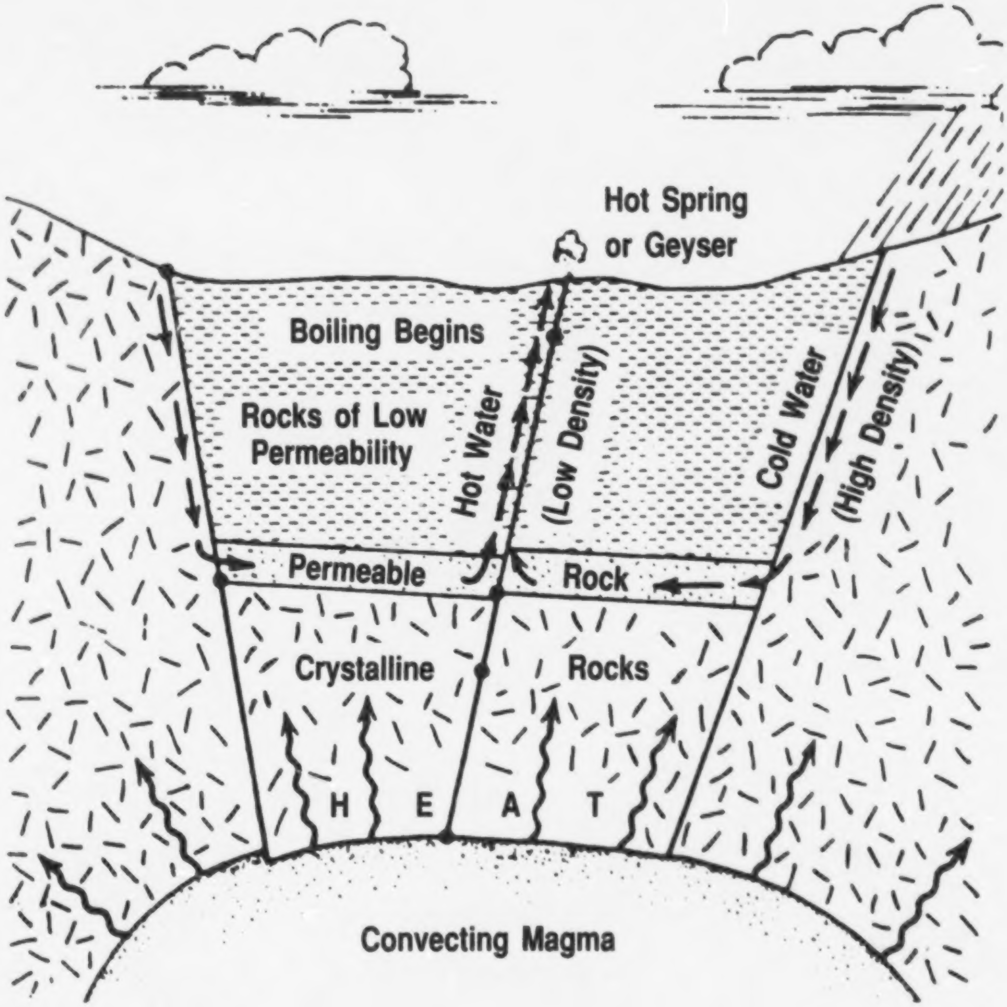

Double-Paned Glass
Absorber Plate (Black)
Liquid in Tubes
Insulation
Roof

TM 7

(NOTE: Heat from sun is absorbed by liquid in absorber plate. Heat is transported through building.)

NR-437

Geothermal Reservoir


Hot Spring
or Geyser
Boiling Begins
Rocks of Low
Permeability
Hot Water
(Low Density)
Cold Water
(High Density)
Permeable
Rock
Crystalline
Rocks
H
E
A
T
Convecting Magma

ENERGY RESOURCES
UNIT IX

INFORMATION SHEET

I. Terms and definitions

A. Barrel (bbl) — A measure of volume of petroleum products; equal to 42 U.S. gallons

B. Combustion — The chemical process of burning which releases heat, light, and chemical by-products

(NOTE: Each time a fuel is burned in a combustion process, some type of pollutant is released into the air.)

C. Energy — The capacity to produce motion, heat, or light

D. Energy conservation — Planned management of energy resources which conserves, protects, and prevents waste

E. Energy reserves — Energy resources which have not been used

F. Energy resources — A measure of national wealth by the production of usable power such as heat and electricity

G. Fossil fuels — Hydrocarbon compounds derived from the remains of organisms (plants and animals) buried millions of years ago

H. Liquified petroleum gas (LPG) — A mixture of heavier gases, principally butane and propane, that are easily liquified at moderate pressure to make them easier to transport; are converted back to gases when pressure is released

(NOTE: LPG should not be confused with liquified natural gas [LNG] that is primarily methane and that has to be put under cold temperatures and higher pressures to be liquified.)

I. Nonrenewable energy — Resources which cannot be replaced once they are used

J. Oil embargo — An order by a government to prohibit oil shipments from its ports, generally prohibiting shipment to specific countries

K. Petroleum — A natural, thick, yellow-to-black, flammable liquid hydrocarbon mixture found principally beneath the earth's surface

L. Recycle -- To reuse or process waste for beneficial purposes

M. Renewable energy — Resources that can be replaced by natural regeneration or human efforts after they are used

INFORMATION SHEET

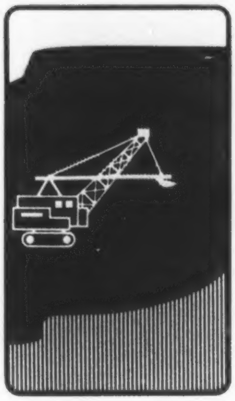
N. Turbine — Rotating device driven by wind or water that is used to provide power

O. Uranium — A radioactive element which gives off energy when its atom is split

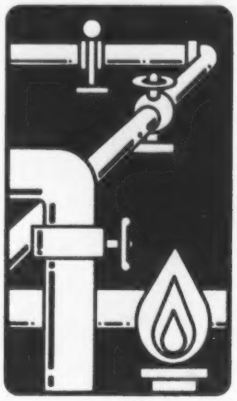
II. Classifications of energy resources

A. Nonrenewable energy resources

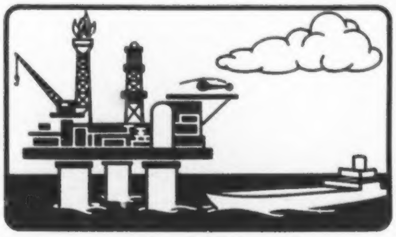
1. Coal



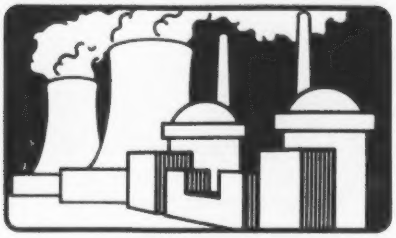
2. Natural gas



3. Oil



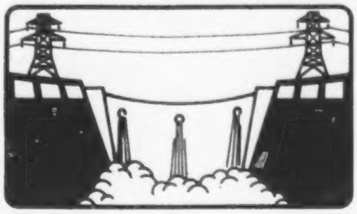
4. Uranium



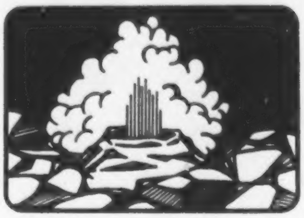
INFORMATION SHEET

B. Renewable energy resources

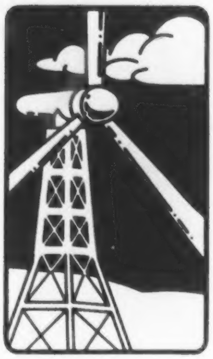
1. Hydropower



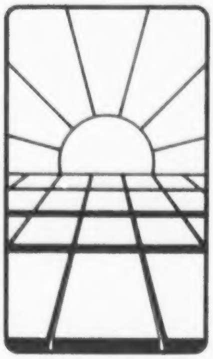
2. Geothermal



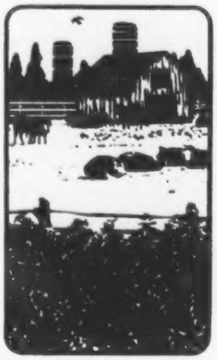
3. Wind



4. Solar



5. Biomass



III. Coal energy resources

A. Coal is a natural, dark brown to black, flammable, solid fossil fuel.

B. Coal is used for heating, electric generation, and as a raw material for many manufactured materials.

C. The cost of producing electricity from coal is 10% higher than electricity produced in nuclear power plants.

D. Environmental considerations of coal use

1. Rehabilitation of surface areas disturbed by strip mining.
2. Transportation of coal from mine to user facility.

INFORMATION SHEET

   3. Air pollutants causing acid rain, greenhouse effect, and smog.
   4. Disposal of 10% of coal as ash following combustion.
   5. Thermal pollution from cooling system.

E. Future of coal as an energy resource

   1. The United States has an abundance of coal to use.
   2. The use of coal will reduce the amount of imported oil needed.

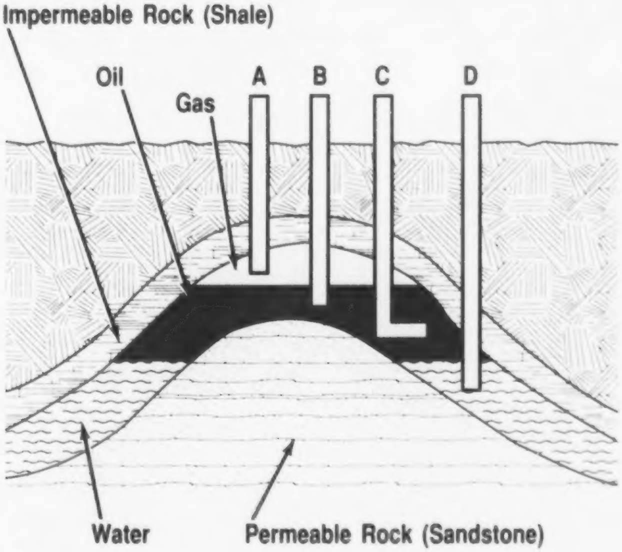
F. Future needs associated with coal use

   1. Air pollutants must be reduced from coal combustion.
   2. Thermal pollution must be reduced.

IV. Oil energy resources

A. Oil (petroleum) is a natural, yellow-to-black, flammable, thick liquid fossil fuel.

B. Oil is produced by drilling a well to the resource formations.



Well A — Gas Well

Well B — Conventional Oil Well

Well C — Horizontally Drilled Oil Well (increases production)

Well D — Water Well

(NOTE: Layers of rock trap oil and natural gas.)

INFORMATION SHEET

1. If the oil bearing formation is under pressure, the oil will flow to the surface.
2. Pumps are placed in the wells that do not flow.

C. Oil is used for heating, transportation fuel, and as a raw material that is refined into gasoline, naphtha, kerosene, lubricating oils, paraffin wax, asphalt, and a wide variety of derivative (petrochemical) products.

D. Oil is relatively economical to use. When used for heat, it compares favorably with coal.

E. Environmental considerations of oil use

1. Producing and abandoned wells are known to pollute ground water.
2. Transporting oil through pipelines and on ships poses an environmental risk.
3. Air pollution from oil use is a major cause of smog, acid rain, and the greenhouse effect.

F. Future of oil use

1. Oil supplies in the U. S. are dwindling.
2. The U.S. imports approximately 50% of the oil it uses. (Amount varies.)

G. Future needs associated with oil use.

1. Alternate energy sources must be developed to reduce the dependence on foreign supplies.
2. Conservation practices must be used to conserve oil supplies.

V. Natural gas energy resources

A. Natural gas is a mixture of hydrocarbon gases, principally methane, also ethane, butane, and propane.

B. Natural gas is generally found in the presence of oil in subsurface formations.

C. Gas is recovered by drilling to the gas bearing formation. Most natural gas formations are pressurized forcing the gas to the surface.

D. Natural gas is used for heating, cooking, transportation (especially when mixed with gasoline to make gasohol), and in the manufacture of organic compounds and products.

E. Natural gas is an economical source of energy which competes favorably with coal.

F. Environmental problems associated with gas combustion are minimal as compared with coal, oil, and nuclear fuels.

   1. Natural gas seldom needs refining prior to use.

   2. By-products of gas combustion add to the greenhouse effect.

G. Limitations of natural gas use

   1. U.S. supplies are short.

   2. Gas must be transported by pipeline, limiting its use.

   (NOTE: When natural gas is put under pressure, it can be liquified which makes it easier to transport.)

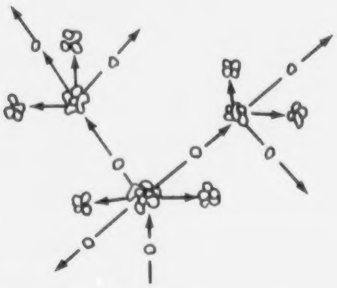
H. Future needs associated with natural gas use

   1. Gas supplies must be conserved.

   2. Alternate energy sources must be developed.

VI. Nuclear energy resources

A. Nuclear energy is produced from uranium which gives off energy when uranium atoms are split.



B. Uranium is a naturally-occurring element.

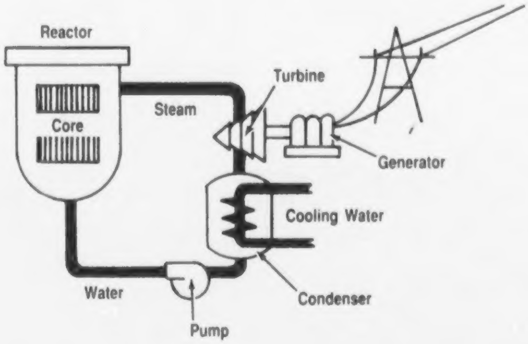
C. While traces of uranium are common in soils around us, commercial quantities are found in Colorado, Wyoming, and along the Texas coast.

D. Uranium is found in pore spaces in sandstone where it was deposited by ground water movement.

E. Uranium is mined by the same methods as coal and other minerals, either by shaft mines or open-pit methods.

INFORMATION SHEET

F. Uranium is primarily used to power nuclear reactors which generate electricity.



G. Nuclear energy created by uranium can produce energy 10% cheaper than coal-fired plants.

H. Environmental problems associated with nuclear energy.

1. Fear of a reactor accident which would release radioactivity to the surrounding area.

2. Disposal of radioactive waste following use because it is deadly and because it lasts so long.

   (NOTE: The half life of radium is 1,580 years which means when it loses half of its strength.)

3. Thermal pollution from cooling systems.

I. Future needs associated with nuclear energy

1. Develop environmentally acceptable methods to dispose of nuclear waste.

2. Reduce the cost of construction of electric generating plants.

3. Promote the use of nuclear energy to conserve oil and gas supplies.

4. Use nuclear energy to reduce air pollutants.

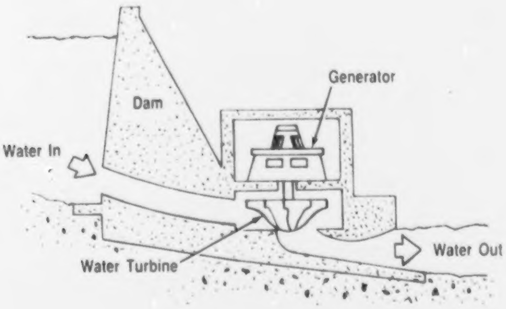
INFORMATION SHEET

VII. Hydropower energy resources

A. Hydropower is energy developed by the force of moving water.

B. Dams are used to harness the energy of falling water.

C. Water flowing through turbines turn generators which produce electricity.



D. The United States currently uses hydropower to generate 14% of its electricity.

E. Hydropower is the most economical source of electricity.

F. Environmental considerations of hydropower.

  1. Dams affect fish and wildlife and destroy scenic rivers.

  2. Dams cause downstream water levels to fluctuate and affect water quality.

G. Future of hydropower

  1. Currently there are 1900 dams in the United States producing electricity.

  2. The number of hydropower generating plants is expected to increase.

VIII. Biomass energy resources

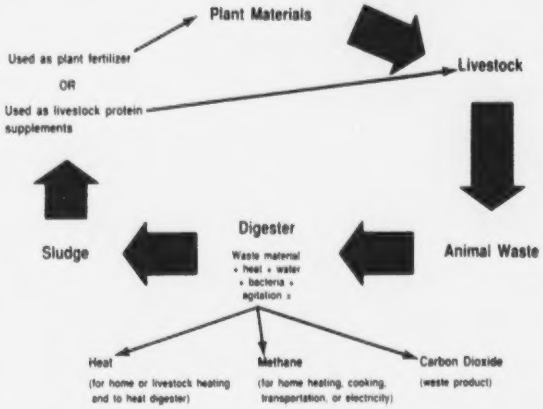
A. Biomass conversion or biogeneration uses plant materials and animal waste as sources of fuel.

  1. Wood is used as a direct heat source and to produce steam for electric generation.

  2. Grain is used to produce alcohol which can be mixed with gasoline and used in internal combustion engines.

INFORMATION SHEET

3. Animal waste and municipal sewage produce methane gas when broken down by bacteria.


Plant Materials
Livestock
Used as plant fertilizer
OR
Used as livestock protein supplements
Animal Waste
Digester
Waste material + heat + water + bacteria + agitation =
Sludge
Heat
(for home or livestock heating and to heat digester)
Methane
(for home heating, cooking, transportation, or electricity)
Carbon Dioxide
(waste product)

B. Wood supplies less than 2% of the total energy demands in the U.S.

C. Alcohol supplies less than 1% of total U.S. energy demands.

D. The economics of biomass as an energy source is dependent on the cost of competing resources such as coal, oil, and natural gas.

E. As grain consumption from alcohol production increases, food prices also increase.

F. The cost of producing alcohol from grain is about three dollars per gallon. (Currently this is over 3 times the cost of gasoline.)

G. Environmental considerations

   1. While the current supply of wood in the U.S. is adequate to supply current needs in biogeneration, increased consumption could result in shortages.

   2. Serious air pollution problems result from wood burning.

   3. Many people feel that grains needed for food should not be used to produce fuel.

   4. When biomass is converted, carbon dioxide is also produced which adds to the greenhouse effect.

H. Future of biomass in energy production

   1. If fossil fuel prices increase, biomass energy will be used more.

   2. Goal for biomass energy is to increase production 11% by the year 2000.

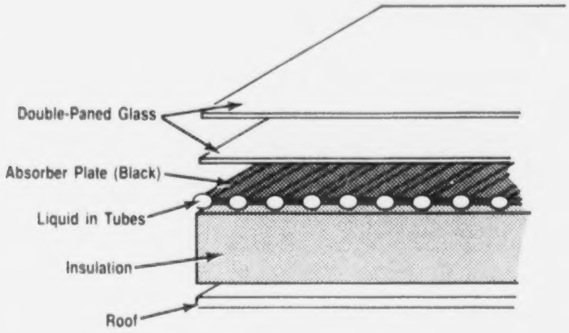
INFORMATION SHEET

IX. Solar energy resources

A. Solar low temperature systems

1. Energy from the sun is converted to useful heat called solar power.

2. Solar collectors are used to store and transmit heat.



3. Solar systems using solar collectors for producing space heat and hot water are very economical.

4. Installation cost of solar systems for an average home ranges from $5,000 to $10,000.

5. Solar systems supply between 40-60% of space heat and hot water needs for a home.

6. Solar systems are not economically competitive at the present time for cooling a home.

7. Environmental considerations of solar energy
   a. Solar energy is a clean source of energy.
   b. Use of solar energy will reduce the amount of pollutants produced by other energy sources.

8. Future of solar energy resources
   a. Solar heating will continue to be used and increase in popularity.
   b. By 1988, over 140,000 solar systems had been installed in homes and commercial buildings.
   c. The U.S. is making an effort to utilize solar energy resources to conserve energy and to reduce its dependence on foreign sources of oil.

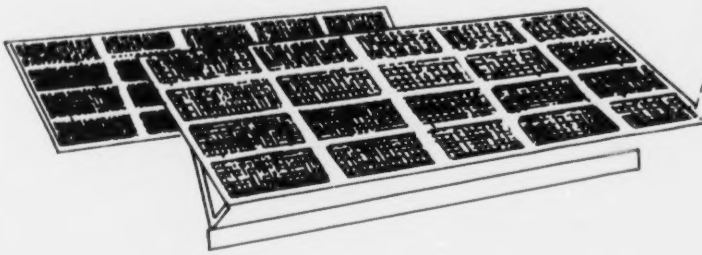
INFORMATION SHEET

B. Solar high temperature systems

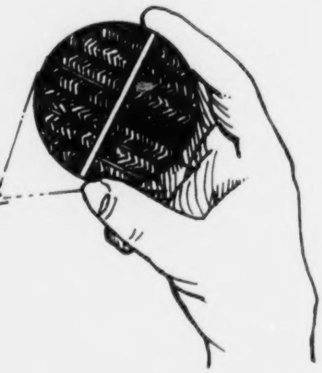
1. High temperature solar systems concentrate sunlight to produce temperatures as high as 480°C (900°F).
2. This temperature is required to convert water to high pressure steam required to turn turbine generators and produce electricity.
3. High temperature systems are not in full commercial operation yet, but cost less to build and operate than coal-fired plants.
4. Environmental problems associated with high temperature systems are few.
    a. Cooling water for condensing steam will present a disposal problem.
    b. A system large enough to supply electricity to 15,000 homes would require 1 square mile of land.
5. Future of high energy systems
    a. Further research and development is needed to increase efficiency.
    b. Land requirements are a concern for large populations.

C. Solar photovoltaic systems

1. Photovoltaic devices use semiconducting materials to convert sunlight directly to electricity (voltage).



Photovoltaic Modules



A Single-Crystal Silicon Solar Cell

2. Materials required to manufacture photovoltaics are available in almost unlimited quantities.

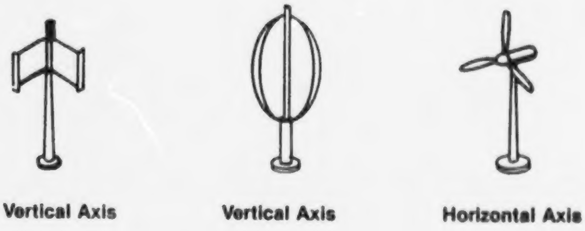
INFORMATION SHEET

3. Electricity produced from photovoltaic systems is currently not economical to use in homes and other commercial applications.
    a. A one square meter photovoltaic cell will run a 100 watt light bulb.
    b. A one square meter photovoltaic cell costs about $400.00.
    c. Enough cells to supply the average home with electricity would cost about $40,000.
    d. Current uses of photovoltaic cells are limited to satellites, remote field applications, and calculators and small electrical devices requiring small quantities of electricity.
4. Environmental problems associated with electrical production from photovoltaic cells are minor.
    a. Disposal of the cells at the end of their 10 year life.
    b. Aesthetics due to the space needed for their use.
5. The future of photovoltaic systems
    a. If efficiency is improved and costs are reduced, photovoltaic electricity could be the energy of the future.
    b. It is estimated that by the year 2000, 5 million Americans will be using electricity generated by photovoltaic cells.

X. Wind energy resources

A. Wind energy is energy developed by the movement of air.

B. Wind energy is usually harnessed by windmills or wind machines.



Types of Wind Machines

INFORMATION SHEET

C. Windmills convert wind energy into mechanical energy which powers electrical generators or mechanical pumps.

D. Electricity produced by windmills for home use is very efficient; however, installation and maintenance cost have restricted their use.

E. Large-scale wind machines capable of producing commercial quantities of electricity are still in the developmental stages.

F. Environmental problems associated with windmills are minimal.

   1. Large wind machines are noisy and distracting.

   2. Birds are killed by their operation.

G. Limitations of wind energy as a power source

   1. Wind speeds of 10 mph are necessary.

   2. Storage batteries are necessary to store energy during low wind conditions.

   3. If storage batteries are not used, an energy backup is necessary during low wind conditions and windmill maintenance.

H. Future of wind energy

   1. Small windmill systems have a promising future in small communities, farms, and rural homes.

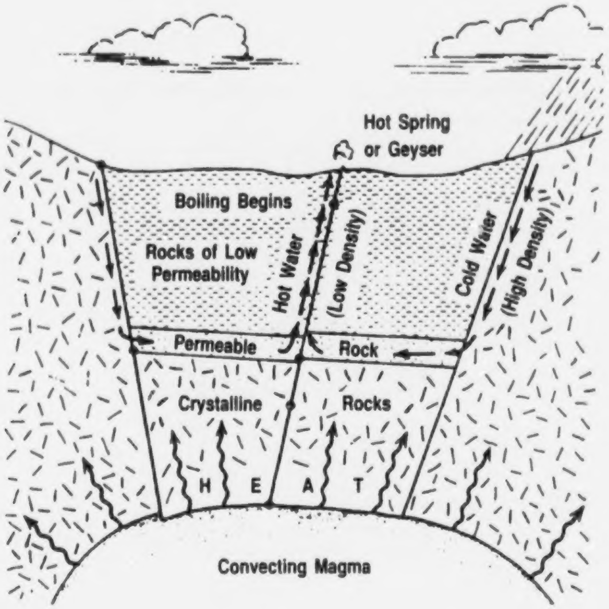
   2. In order to supply 1% of U.S. energy needs, approximately 3000 large windmills and 30,000 small windmills would be needed.

   3. Some experts predict that 3% of U.S. energy needs will be supplied by windmills by the year 2000.

INFORMATION SHEET

XI. Geothermal energy resources

A. Geothermal energy is produced by drilling wells to underground steam formations.


Hot Spring
or Geyser
Boiling Begins
Rocks of Low
Permeability
Hot Water
(Low Density)
Cold Water
(High Density)
Permeable
Rock
Crystalline
Rocks
H
E
A
T
Convecting Magma

B. Steam from pressurized formations is used to drive turbine generators which produce electricity.

C. Electricity produced from geothermal energy is competitive with other energy resources.

D. Environmental considerations

1. Air pollution from hydrogen sulfide gas in steam
2. Water pollution from salt in the geothermal steam
3. Increased seismic activity when steam pressures are reduced

E. Future uses of geothermal energy are promising.

1. Electric generation
2. Space heating in homes and industry
3. Greenhouse heating

INFORMATION SHEET

F. Limitations of geothermal energy

  1. Environmental problems must be solved.

  2. Most geothermal resources are located in the West.

XII. U.S. energy reserves (based on current consumption)

(NOTE: Energy reserves are vital to the national economy, security, and standard of living of the American peopie.)

A. Coal

  1. The U.S. coal reserves are the largest in the world, representing 25% of the world's total.

  2. This will supply U.S. needs for 300 years at present rate of consumption.

B. Natural gas

  1. This reserve would supply the U.S. for 54 years.

  2. Discovered resources of natural gas will supply 33 years.

  3. Undiscovered resources of natural gas will supply 21 years.

C. Oil

  1. Oil reserves in the U.S. will supply U.S. needs for 36 years. (This includes proven and undiscovered reserves.)

  2. The U.S. has only 4% of the world's supply of oil.

  3. The U.S. now imports 50% of its oil from other countries.

  4. The U.S. imports most of its oil from the Middle East which has 66% of the world's supply.

D. Uranium/nuclear fuel

  1. The U.S. has 25% of the world's supply of this energy resource.

  2. This supply will last 200-300 years.

  3. Nuclear energy currently supplies 17% of the electricity used in the U.S.

E. The U.S. is currently using 42% its hydropower resources.

F. Geothermal, solar, biomass, and wind energies have great potentials; however, due to higher costs they will produce less than 3% of U.S. energy in the near future.

INFORMATION SHEET

XIII. Uses of oil resources in the U.S.

A. Residential — 20.7% (5 million BBL/day)

- Heating and air conditioning
- Lighting
- Appliances

B. Commercial/business — 14.6% (3.5 million BBL/day)

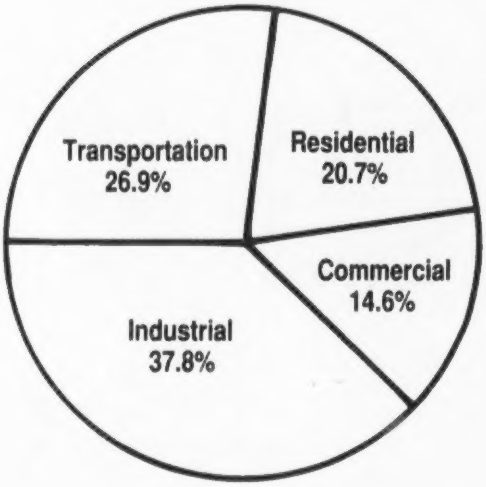
- Lighting
- Heating and air conditioning
- Light machinery

C. Industrial — 37.8% (8.6 million BBL/day)

- Heavy machinery
- Heating and air conditioning
- Refining processes
- Manufacturing processes and products

D. Transportation — 26.9% (6.4 million BBL/day)

- Cars and light trucks — 74%
- Trucks, trains, buses, and ships — 26%



INFORMATION SHEET

XIV. Goals of energy conservation

A. To save money

B. To improve the environment by reducing harmful emissions from energy use

C. To reduce the amount of energy that must be produced to meet demands

D. To reduce our reliance on foreign energy sources for political and economic reasons

XV. Ways to conserve energy

A. Residential — Uses 8% of total U.S. energy

1. Build energy-efficient homes.
2. Insulate and weatherstrip existing homes.
3. Turn off lights when not needed.
4. Reduce thermostat settings in winter.
5. Purchase energy-efficient appliances.
6. Conserve hot water use.
7. Recycle household products and compost yard waste.

B. Transportation — Uses 19% of total U.S. energy

1. Increase vehicle fuel economy by reducing weight.
2. Reduce speed.

   (NOTE: When the national speed limit was reduced to 55 mph, 200,000 barrels of oil per day were saved.)
3. Use car pools.
4. Increase fuel-efficiency of engines.
5. Improve aerodynamics of vehicle design.

C. Commercial/businesses — Uses 5% of total U.S. energy

1. Similar to residential efforts including energy-efficient buildings and conservation measures.
2. Install alternate energy devices such as solar.

INFORMATION SHEET

D. Industrial — Uses 26% of total U.S. energy

1. Turn off equipment when not in use.
2. Improve equipment efficiency.
3. Improve manufacturing processes.
4. Reuse heat generated.
5. Recycle raw materials.

E. Electricity generation — Uses 42% of total U.S. energy

1. Conserve energy resources which are in short supply in the U.S.
2. Generate electricity by converting to U.S. energy resources which are renewable or that will last several hundred years such as coal, nuclear, hydropower, solar, or wind energy.

XVI. Careers in energy resources

A. Engineer — petroleum, mining, nuclear

B. Geologist

C. Chemist

D. Physicist — nuclear, geologic

E. Mineralogist

(NOTE: The careers listed above are professional careers requiring college degrees. Numerous other positions such as technicians, aides, and laborers are available. Starting salaries are generally higher in the energy industry than in other regional careers. Salaries will depend on education level and job experience.)

ENERGY RESOURCES
UNIT IX

ASSIGNMENT SHEET #1 — DISCUSS THE EFFECTS OF A MIDDLE EAST OIL EMBARGO

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Effects are feasible and well thought out	______
Lists are thorough	______
Class discussion/participation	______
Assignment was neat and completed on time	______

Directions:

1. Use two separate sheets of paper.
2. Assume the U.S. receives 50% of its oil from Middle East countries.
3. On one sheet list the effects of a Middle East oil embargo on the U.S.
4. On the other sheet list the effects on you personally.
5. Discuss your lists in class.

ENERGY RESOURCES
UNIT IX

ASSIGNMENT SHEET #2 — COMPARE ELECTRIC PRODUCTION FROM COAL AND NUCLEAR FUELS

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Comparisons are logical	______
Comparisons are thorough	______
Assignment is neat and completed on time	______

Directions: Compare the positive and negative aspects of electric production from coal and nuclear fuels. Cover the following points:

1. Renewable or nonrenewable resource
2. Economics
3. Safety
4. Environmental problems
5. Future use

What are your personal concerns about using coal and nuclear fuel?

ENERGY RESOURCES
UNIT IX

ASSIGNMENT SHEET #3 — RESEARCH AND REPORT ON USING AGRICULTURE PRODUCTS AS ALTERNATIVE ENERGY RESOURCES

NAME ____________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Report is thorough	______
Report is informative	______
Report is neat and completed on time	______

Directions:

1. Research the biomass conversion process.
2. List the agricultural products which can be used.
3. Identify and describe how these products are used as alternative energy resources.
4. Give your opinion of the future of agricultural products as alternative energy sources.
5. Compile your information into a report (written or oral).

ENERGY RESOURCES
UNIT IX

ASSIGNMENT SHEET #4 — PERFORM AN ENERGY AUDIT OF YOUR HOME

NAME ______________________________ SCORE __________

EVALUATION CRITERIA

Criteria	Rating
Audit is completed as required	______
Recommendations are appropriate	______

Directions: Complete the following inspection of your home and then make recommendations for improvement. Take notes on your inspection form.

1. Inspect doors to the outside.
   a. Does house have storm doors? __________
   b. Do doors have weatherstripping? __________
   c. Are doors properly caulked? __________
   d. How many layers of glass are there in the doors?
      ☐ single pane
      ☐ double pane
      ☐ triple pane
2. Inspect windows
   a. Do windows close tightly? __________
   b. Are window frames properly caulked? __________
   c. Are there any broken windows? __________
   d. How many layers of glass are there in the windows?
      ☐ single pane
      ☐ double pane
      ☐ triple pane

ASSIGNMENT SHEET #4

e. Are storm windows used during cold winter months? __________

f. What kind of frames do the windows have? (wood, metal, some of each) __________

g. How are windows covered inside to control light and prevent heat loss and gain?

Blinds _____

Shutters _____

Shades _____

Curtains _____

Drapes _____

Reflective coating _____

Other _____

None _____

h. How many windows are located on each outside wall?

North _____

East _____

South _____

West _____

3. Inspect home exterior.

a. Is re-caulking needed? __________

b. Are other repairs needed to prevent heat loss? __________

c. Are plumbing entries tightly sealed? __________

d. Are crawl-space entries sealed? __________

e. Are mail-slots closing tightly? __________

f. Are dryer outlets sealed? __________

g. Are air-conditioning outlets sealed? __________

h. Are other exhaust outlets sealed? __________

4. Check for airleaks.

a. Shut off forced-air furnace (if used in your home), and use a draft indicator to check doors. Are there air leaks? __________

b. Are there leaks around windows? __________

c. Are there leaks around corners of exterior walls? __________

d. Are there leaks around floor and floor boards? __________

e. Are there leaks around plumbing entries under sinks along exterior walls? __________

ASSIGNMENT SHEET #4

f. Are there leaks around electrical outlets on exterior walls? __________

g. Turn heat back on if you turned it off in Step 4a.

5. Inspect insulation and find out what kind of insulation the home has.

a. Is there blown-in or blanket insulation in the attic or ceiling area? __________ What thickness? __________ What R-value? __________

b. Is there insulation in the walls? __________

c. Is there insulation in the floors/foundation? __________

d. Complete the following chart if the information is available.

FIGURE 1

Area	Recommended R-value	Insulation		R-value of Insulation
		Yes	No	
Ceiling/Roof				
Walls				
Floors/ Foundation				

6. Inspect lighting.

a. Are lights left on in rooms or areas when not in use? __________

b. Are fluorescent bulbs used in lights and fixtures whenever possible? __________

c. Are walls a light color for good reflection? __________

d. What kind of natural lighting is used? (windows, skylights) __________

7. Inspect fireplace if the home has one.

a. Is the vent closed when not in use? __________

b. Does fireplace have glass doors to prevent heat loss? __________

c. Does fireplace have a method of circulating air and heat? __________

ASSIGNMENT SHEET #4

8. Inspect hot water heater.

   a. Check water temperature with thermometer.

   b. Record temperature. __________

   c. Are hot water pipes and water heater insulated? __________

   d. Are any hot water faucets leaking? __________

   e. Are the clothes washer and dishwasher used only with full loads? __________

   f. Are flow restrictors used on shower heads and sink faucets? __________

9. Check heating, ventilation, and air conditioning.

   a. Complete the following table (change names to fit rooms in the home.)

FIGURE 2

Room	Actual Temp.	Heat or Air Cond. Register		Thermostat in Room		Thermostat Setting
		Open	Closed	Yes	No	
Living						
Dining						
Kitchen						
Bathroom						
Bedroom 1						
Bedroom 2						
Hall						

   b. Is the thermostat lowered at night? __________

   c. Is the thermostat set at 65°F or lower in the heating season and 78°F or higher in the cooling season? __________

   d. Is the heating system forced air or a convection system? __________

   e. Are heating and cooling vents clean and unblocked? __________

   f. Are there filters on air conditioners and furnaces? __________

   g. Are filters clean and unclogged? __________

ASSIGNMENT SHEET #4

h. Are air ducts insulated? ___________

i. Are hot water pipes insulated? ___________

j. Are kitchen and bathroom exhaust fans turned off when not needed? ___________

10. Make recommendations for improvements by filling in the chart below.

LOW COST RECOMMENDATIONS	HIGH COST RECOMMENDATIONS

ENERGY RESOURCES
UNIT IX

TEST

NAME ______________________________ SCORE __________

1. Match the terms on the right with the correct definitions.

______a. A radioactive element which gives off energy when its atom is split

______b. Planned management of energy resources which conserves, protects, and prevents waste

______c. To reuse or process waste for beneficial purposes

______d. Energy resources which have not been used

______e. Energy resources that can be replaced after use

______f. An order by a government to prohibit oil shipments

______g. The chemical process of burning which releases heat, light, and chemical by-products

______h. Rotating device driven by wind or water that is used to provide power

1. Barrel
2. Combustion
3. Energy
4. Energy conservation
5. Energy reserves
6. Energy resources
7. Fossil fuels
8. Nonrenewable energy
9. Oil embargo
10. Recycle
11. Renewable energy
12. Turbine
13. Uranium

2. Classify the following energy resources as renewable (R) or nonrenewable (N).

______a. Wind

______b. Biomass

______c. Oil

______d. Solar

______e. Coal

______f. Uranium

______g. Hydropower

______h. Natural gas

______i. Geothermal

TEST

3. Complete the following statements on coal energy resources by circling the correct answers.

   a. Coal is a dark brown to black, flammable, (liquid, solid) fossil fuel.

   b. The cost of producing electricity from coal is 10% higher than electricity produced in (nuclear, biomass) power plants.

   c. A major environmental concern of coal use is (air pollution, water pollution).

4. Select true statements concerning oil energy resources by placing a T or F next to the true or false statements.

   ______a. Oil can be refined into many products.

   ______b. Oil is produced by drilling a well to the resource formation.

   ______c. Oil is much more expensive to use than coal.

   ______d. Oil wells are known to pollute ground water.

   ______e. Using oil poses no threat to the environment.

5. Select true statements concerning natural gas energy resources by placing a T or F next to the true or flase statements.

   ______a. Natural gas is principally composed of ethane.

   ______b. Natural gas is generally found in the presence of oil in subsurface formations.

   ______c. Environmental problems associated with natural gas are minimal as compared with coal, oil, and nuclear fuels.

6. Complete the following statements concerning nuclear energy resources by circling the correct answers.

   a. Uranium is a (man-made, naturally-occurring) element.

   b. Commercial quantities of uranium are found in (Oklahoma, Colorado).

   c. Uranium is (mined like coal, drilled like oil).

   d. An environmental problem associated with nuclear energy is (air pollution, radioactive waste).

TEST

7. Select true statements concerning hydropower energy resources by placing a T or F next to the true or false statements.

    _______a. Hydropower is the process of wind turning turbines which turn alternators which generate electricity.

    _______b. Dams are used to harness hydropower.

    _______c. The U.S. is currently using only 2% of its hydropower resources.

    _______d. Hydropower is the most economical source of electricity.

    _______e. The most serious environmental concern about hydropower is air pollution.

8. Complete statements concerning biomass energy resources by circling the correct words.

    a. Plant materials and animal (parts, waste) are used as sources of fuel in biomass conversion.

    b. Using biomass as a direct heat source can result in serious (disease, pollution) problems.

9. Select true statements concerning solar energy resources by placing a T or F next to the true or false statements.

    _______a. Solar collectors are used to store and transmit heat.

    _______b. Solar systems are very economical for cooling homes and businesses.

    _______c. Installation of solar systems is very inexpensive, only around $500 today.

    _______d. Solar energy is a clean source of energy.

    _______e. Low temperature solar systems can be used to produce electricity.

    _______f. The materials for photovoltaic devices are in limited supply.

    _______g. The cost of the raw materials for photovoltaic cells is the reason that photovoltaic systems are expensive.

10. Complete statements concerning wind energy resources by circling the correct words.

    a. Wind energy is usually harnessed by (wind machines, air turbines).

    b. Wind energy (is, is not) very damaging to the environment.

    c. Wind speeds of (10, 40) mph are necessary for wind energy.

TEST

11. Select true statements concerning geothermal energy resources by placing a T or F next to the true or false statements.

______a. Geothermal energy is produced by drilling wells to underground steam formations.

______b. Electricity produced from geothermal sources is very expensive compared to other energy sources.

______c. Geothermal energy is very clean and creates no pollution problems.

______d. Most geothermal resources are located in the South.

12. Match U.S. energy resources with their correct reserve supplies.

______a. U.S. has 4% of the world's supply

______b. U.S. has 25% of the world's supply

______c. U.S. has enough for 54 years

______d. U.S. has enough for 300 years

1. Coal
2. Hydropower
3. Natural gas
4. Oil
5. Uranium

13. Match the oil resources with the correct percentages of use in the U.S.

______a. 14.6%

______b. 20.7%

______c. 26.9%

______d. 37.8%

1. Commercial/business
2. Industrial
3. Residential
4. Transportation

14. Select from the following list the goals of energy conservation by placing an "X" next to the appropriate goals.

______a. To save money

______b. To produce more energy sources

______c. To use more energy

______d. To improve the environment by reducing harmful emissions

______e. To reduce our reliance on foreign energy for political and economic reasons

TEST

15. List two ways to conserve energy for each of the following energy uses.

    a. Residential

        1) ____________________

        2) ____________________

    b. Transportation

        1) ____________________

        2) ____________________

    c. Commercial/businesses

        1) ____________________

        2) ____________________

    d. Industrial

        1) ____________________

        2) ____________________

    e. Electricity generation

        1) ____________________

        2) ____________________

16. List three careers in energy resources.

    a. ____________________

    b. ____________________

    c. ____________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

17. Discuss the effects of a Middle East oil embargo. (Assignment Sheet #1)

18. Compare electric production from coal and nuclear fuel. (Assignment Sheet #2)

19. Research and report on using agriculture products as alternative energy resources. (Assignment Sheet #3)

20. Perform an energy audit of your home. (Assignment Sheet #4)

ENERGY RESOURCES
UNIT IX

ANSWERS TO TEST

1. a. 13
   b. 4
   c. 10
   d. 5
   e. 11
   f. 9
   g. 2
   h. 12

2. a. R
   b. R
   c. N
   d. R
   e. N
   f. N
   g. R
   h. N
   i. R

3. a. Solid
   b. Nuclear
   c. Air pollution

4. a. T
   b. T
   c. F
   d. T
   e. F

5. a. F
   b. T
   c. T

6. a. Naturally-occurring
   b. Colorado
   c. Mined like coal
   d. Radioactive waste

7. a. F
   b. T
   c. F
   d. T
   e. F

8. a. Waste
   b. Pollution

ANSWERS TO TEST

9. a. T e. F
   b. F f. F
   c. F g. F
   d. T

10. a. Wind machines
    b. Is not
    c. 10

11. a. T
    b. F
    c. F
    d. F

12. a. 4
    b. 5 or 1
    c. 3
    d. 1 or 5

13. a. 1
    b. 3
    c. 4
    d. 2

14. a, d, e

15. Any two of the following for **each:**

    a. Residential

    1) Build energy-efficient homes.
    2) Insulate and weatherstrip existing homes.
    3) Turn off lights when not needed.
    4) Reduce thermostat settings in winter.
    5) Purchase energy-efficient appliances.
    6) Conserve hot water use.
    7) Recycle household products and compost yard waste.

    b. Transportation

    1) Increase vehicle fuel economy by reducing weight.
    2) Reduce speed.
    3) Use car pools.
    4) Increase fuel-efficiency of engines.
    5) Improve aerodynamics of vehicle design.

ANSWERS TO TEST

c. Commercial/businesses

1) Similar to residential conservation efforts — Students may list several.
2) Install alternate energy devices such as solar.

d. Industrial

1) Turn off equipment when not in use.
2) Improve equipment efficiency.
3) Improve manufacturing processes.
4) Reuse heat generated.
5) Recycle raw materials.

e. Electricity generation

1) Conserve energy resources which are in short supply in the U.S.
2) Generate electricity by converting to U.S. energy resources which are renewable or that will last several hundred years.

16. Any three of the following:

a. Engineer — Petroleum, mining, nuclear
b. Geologist
c. Chemist
d. Physicist — Nuclear, geologic
e. Mineralogist

17. - 20. Evaluated to the satisfaction of the instructor.